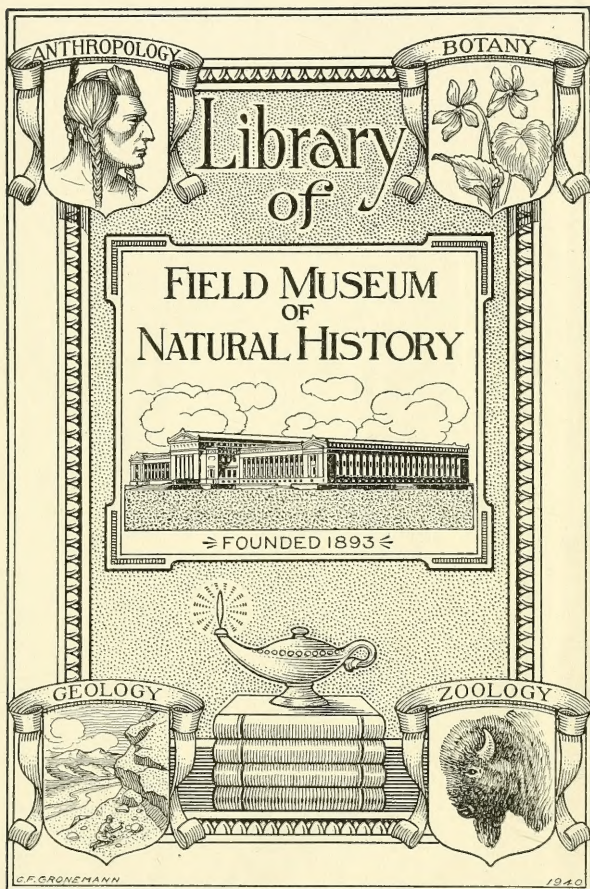




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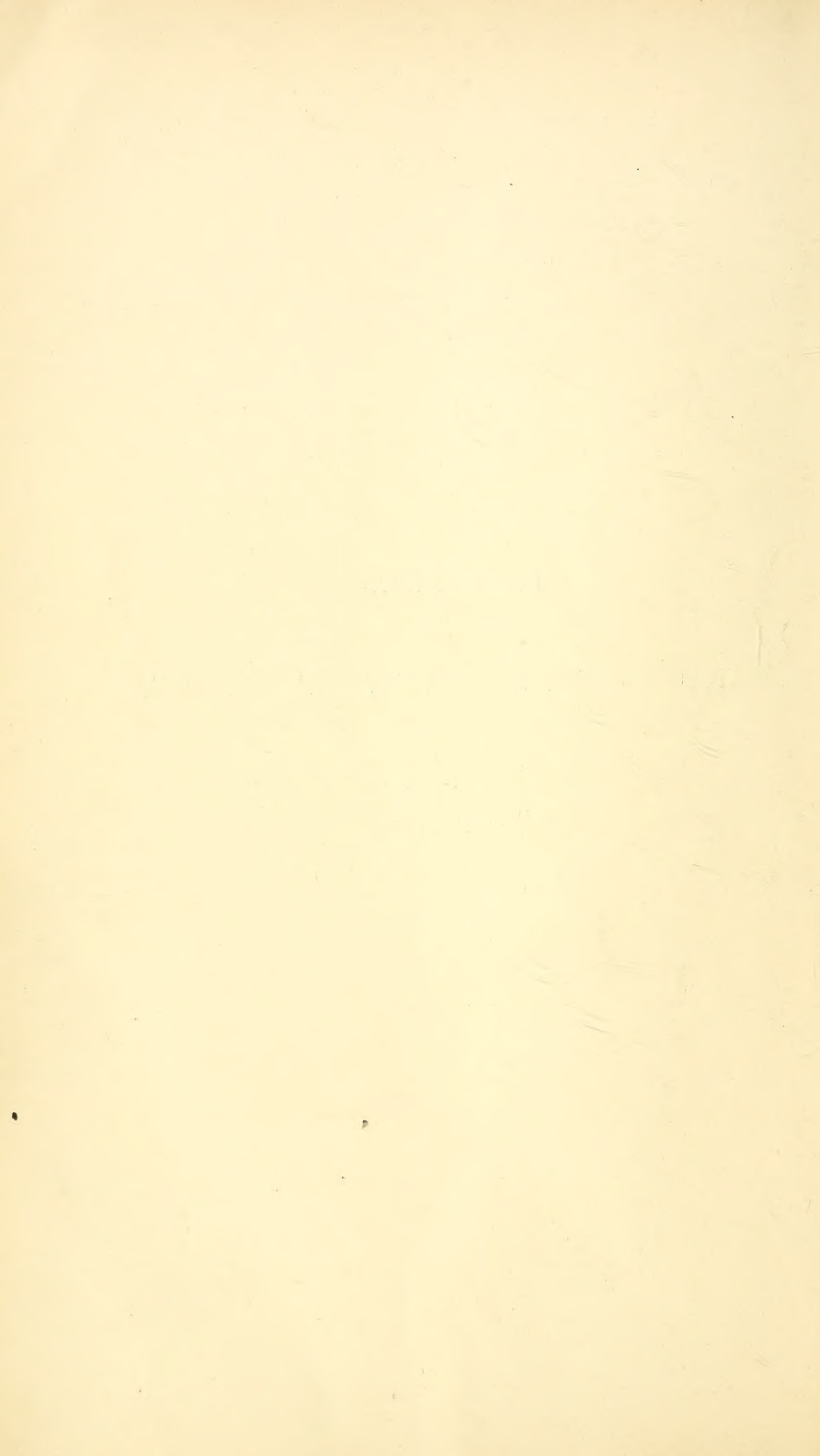
PROCEEDINGS

OF THE

MALACOLOGICAL SOCIETY OF LONDON.

VOL. IX.

1910—1911.



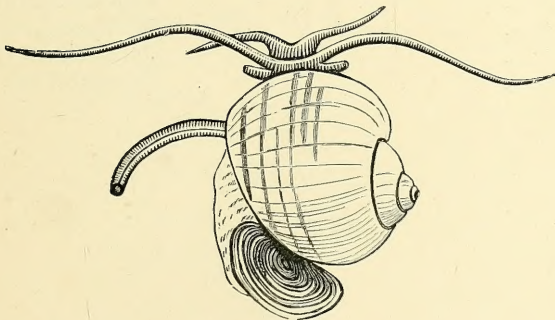
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PROCEEDINGS
OF THE
MALACOLOGICAL SOCIETY
OF LONDON.

EDITED BY
E. A. SMITH, I.S.O., F.Z.S.
Under the direction of the Publication Committee.

VOLUME IX.

1910—1911.



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CONTENTS OF VOL. IX.

PROCEEDINGS :—

	PAGE
Ordinary Meeting, November 12th, 1909	1
" " December 10th, "	2
" " January 14th, 1910	2
Annual Meeting, February 11th, "	86
Ordinary Meeting, February 11th, "	87
" " March 11th, "	87
" " April 8th, "	88
" " May 13th, "	149
" " June 10th, "	149
" " November 11th, "	225
" " December 9th, "	225
" " January 13th, 1911	226
Annual Meeting, February 10th, "	276
Ordinary Meeting, February 10th, "	277
" " March 10th, "	277
" " April 7th, "	278
" " May 12th, "	329
" " June 9th, "	330

NOTES :—

PAGE

Note on an abnormal specimen of <i>Nautilus pompilius</i> . By E. A. SMITH, I.S.O.	4
Note on the Egg-capsules of <i>Melo</i> . By E. A. SMITH, I.S.O.	4
Note on Feeding of <i>Helix desertorum</i> , Forsk., in Captivity. By Mrs. G. B. LONGSTAFF, F.L.S.	5
On the occurrence in the British Isles of living specimens of <i>Pisidium Steenbuchii</i> , Mörch, and <i>P. Lilljeborgii</i> , Clessin, with notes of new records of <i>Pisidia</i> for the Lake District, and fresh localities for <i>P. supinum</i> , A. Schm. By B. B. WOODWARD, F.L.S.	5
Note on <i>Athoracophorus Schauinslandi</i> . By H. SUTER	6
Note on further British Localities for <i>Pisidium Steenbuchii</i> , Möller, and <i>P. Lilljeborgii</i> , Clessin. By B. B. WOODWARD, F.L.S.	150
Note on <i>Triton tessellatus</i> , Reeve. By Major A. J. PEILE, R.A. (Fig.)	227
Note on <i>Chiton Torri</i> . By C. HEDLEY, F.L.S.	227
Note on a new Armorican locality for <i>Elona Quimperiana</i> , Fér. By H. B. PRESTON, F.Z.S.	227
Note on <i>Macrochlamys (Eurychlamys) platychlamys</i> (Blanford), etc. By Major A. J. PEILE, R.A.	281

OBITUARY NOTICES :—

Miss J. E. Linter. By E. A. SMITH, I.S.O.	89
Rev. George Ferris Whidborne. By R. B. NEWTON, F.G.S.	89
Rev. R. Boog Watson. By E. A. SMITH, I.S.O.	279
Dr. Oscar Boettger. By E. A. SMITH, I.S.O.	279

PRESIDENTIAL ADDRESS :—

A Sketch of the chief Geological Zones and their Mollusca. By R. B. NEWTON, F.G.S.	282
--	-----

PAPERS :—

Note on the identity of <i>Calliostoma Sowerbyi</i> , Pilsbry, with <i>C. haliarchus</i> , Melvill. By J. C. MELVILL, F.L.S.	7
Note on some species of Mollusca collected in China from 1904 to 1907, with descriptions of new species. By Staff-Surgeon K. H. JONES, R.N., and H. B. PRESTON, F.Z.S. (Figs.)	9
Notes on the genus <i>Erato</i> , with a list of the known recent species. By E. A. SMITH, I.S.O.	13
Note on the very young stage of the genus <i>Humphregia</i> . By E. A. SMITH, I.S.O. (Figs.)	23
Description of <i>Thersites (Glyptorhagada) Hillieri</i> , n.sp., from South Central Australia. By E. A. SMITH I.S.O. (Fig.)	26

PAPERS (*continued*)—

PAGE

Some remarks with regard to Professor Bourne's monograph on the Neritidæ. By Dr. H. SIMROTH. (Figs.)	27
Note on <i>Sculptaria</i> , Pfeiffer. By J. H. PONSONBY, F.Z.S.	34
Notes on the genus <i>Libera</i> . By J. H. PONSONBY, F.Z.S.	37
A further note on the anatomical differences between the genera <i>Cypræa</i> and <i>Trivia</i> . By H. O. N. SHAW, F.Z.S.	44
Notes on the references to certain groups, etc., used in the classification of Mollusca. By H. O. N. SHAW, F.Z.S.	45
A new Mexican genus of Pleuroceratidæ. By Professor H. A. PILSBRY. (Figs.)	47
Notes on a small collection of terrestrial shells from Angola, with descriptions of new species. By H. B. PRESTON, F.Z.S. (Figs.)	51
Notes on the family Ampullariidæ. By G. B. SOWERBY, F.L.S. (Figs.)	56
Descriptions of new species of <i>Donovania</i> , <i>Pisania</i> , <i>Phenacolepas</i> , and <i>Fissurella</i> . By G. B. SOWERBY, F.L.S. (Figs.)	65
On Marine Mollusca from the Kermadec Islands, and on the ' <i>Sinusigera apex</i> '. By T. IREDALE	68
Notes on a collection of Helicoid Land Shells from New Guinea. By G. K. GUDE, F.Z.S. (Figs.)	80
Notes on Polyplacophora, chiefly Australasian. Part I. By T. IREDALE	90
On <i>Unio</i> , <i>Margaritana</i> , <i>Pseudanodonta</i> , and their occurrence in the Thames Valley. By FRITZ HAAS	106
Description of <i>Vivipara fragilis</i> , n.sp., from Dutch New Guinea. By H. B. PRESTON, F.Z.S. (Fig.)	113
On an undescribed <i>Anodonta</i> from the English Wealden Formation, with remarks on the other Unionidæ of the same period. By R. B. NEWTON, F.G.S. (Plate I.)	114
Notes on (I) Pleistocene, (II) Holocene, (III) Recent non-marine Shells from Mallorca; (IV) Marine Shells associated with the Holocene deposits; (V) Marine Shells from Alcudia, Mallorca; (VI) Non-marine Shells from Manresa, Cataluna. By Rev. R. A. BULLEN, B.A., F.L.S. (Figs.)	118
On the occurrence in England of <i>Valvata macrostoma</i> , Steenbuch. By A. S. KENNARD, F.G.S., and A. W. STELFOX	123
Description of a new species of <i>Helicodonta</i> from Spain. By G. K. GUDE, F.Z.S. (Fig.)	124
The Distribution of <i>Margaritana margaritifera</i> (Linn.) in North America. By BRYANT WALKER. (Plate II.)	126
Description of a new species of <i>Voluta</i> from West Australia. By Dr. J. C. COX. (Plate III.)	146

PAPERS (*continued*)—

PAGE

Description of a new species of <i>Latirus</i> . By J. C. MELVILL, M.A., F.L.S. (Fig.)	147
The genus <i>Cremnobates</i> , Swainson. By C. HEDLEY and H. SUTER. (Fig.)	151
Notes on Polyplacophora, chiefly Australasian. Part II. By T. IREDALE	153
Notes on and Additions to the Terrestrial Molluscan Fauna of Southern Abyssinia. By H. B. PRESTON, F.Z.S. (Figs.)	163
A Revision of the Species of the family Pyramidellidæ occurring in the Persian Gulf, Gulf of Oman, and North Arabian Sea. By J. C. MELVILL, M.A., D.Sc. (Plates IV–VI.)	171
On the Anatomy of <i>Rhysota Foulliogi</i> . By R. H. BURNE, M.A., F.Z.S. (Plates VII and VIII.)	208
Further Notes on the Dates of Issue of the Parts of Sowerby's <i>Conchological Illustrations</i> . By A. REYNELL	212
On <i>Petricola</i> , <i>Lucinopsis</i> , and the family Petricolidæ. By A. J. JUKES-BROWNE, F.R.S., F.G.S.	214
Descriptions of new Melaniidæ from Goram and Kei Islands, Malay Archipelago. By H. B. PRESTON, F.Z.S. (Fig.)	228
Description of a new species of <i>Pachychilus</i> from Cuba. By H. B. PRESTON, F.Z.S. (Fig.)	229
On the Anatomy of the British species of the genus <i>Psammodia</i> . By H. H. BLOOMER, F.L.S. (Plates IX and X.)	231
Note on the Animal of the genus <i>Cleopatra</i> . By E. A. SMITH, I.S.O. (Figs.)	240
On the names used by Bolten and Da Costa for genera of Veneridæ. By A. J. JUKES-BROWNE, F.R.S., F.G.S.	241
On some Misapplied Molluscan Generic Names. By T. IREDALE.	253
A Collation of J. C. Chenu's <i>Illustrations Conchyliologiques</i> and a note on P. L. Duclos' <i>Hist. Nat. gén. et part. Coquilles</i> . By C. D. SHERBORN, F.Z.S., and E. A. SMITH, I.S.O.	264
Description of a new species of <i>Helicodonta</i> from Tenerife. By G. K. GUDE, F.Z.S. (Figs.)	268
Note on some preoccupied molluscan generic names and proposed new genera of the family Zonitidæ. By G. K. GUDE, F.Z.S.	269
Presidential Address, entitled "A Sketch of the chief Geological Zones and their Mollusca". By R. BULLEN NEWTON, F.G.S.	282
On the recent species of the genus <i>Vulsella</i> . By E. A. SMITH, I.S.O. (Plate XI.)	306
On a new species of <i>Phasianella</i> from South Africa. By E. A. SMITH, I.S.O. (Figs.)	313
A list of Marine Shells occurring at Christmas Island, Indian Ocean, with descriptions of new species. By E. A. SMITH, I.S.O. (Figs.)	315

PAPERS (<i>continued</i>)—	PAGE
On the value of the Gastropod Apex in Classification. By T. IREDALE	319
On <i>Valvata Woodwardi</i> , n.sp., and <i>Sphærium Bulleni</i> , n.sp., from the Cromerian (Forest Bed) of West Runton, Norfolk. By A. S. KENNARD, F.G.S. (Figs.)	324
Description of <i>Oxytes Beddomei</i> , n.sp., from Upper Burma. By Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S. (Figs.)	327
On the Mollusca procured during the "Porcupine" Expeditions, 1869-70. Supplemental Notes, Part IV. By E. R. SYKES, B.A., F.L.S. (Figs.)	331
Some remarks on the Nomenclature of the Veneridæ. By Dr. W. H. DALL	349
Description of a new species of the genus <i>Conus</i> from South Africa. By G. B. SOWERBY, F.L.S. (Figs.)	352
A Modification in the Form of Shell (<i>Siphonaria Algesiræ</i> , Quoy) apparently due to Locality. By the Rev. A. H. COOKE, M.A. (Figs.)	353
Description of a new species of <i>Acmæa</i> from Bombay, and notes on other forms from that locality. By E. A. SMITH, I.S.O. (Figs.)	356
Diagnoses of three new Operculate Land Shells from Grand Cayman Island. By H. B. PRESTON, F.Z.S. (Figs.)	359
Further note on preoccupied Molluscan Generic Names and a proposed new genus of the family Helicidæ. By G. K. GÜDE, F.Z.S. (Figs.)	361
On the modifications in form of the Upper Tertiary lacustrine shells of the Island of Cos, as first observed by Edward Forbes and T. A. B. Spratt. By R. B. NEWTON, F.G.S. (Plate XII.)	363

LIST OF ILLUSTRATIONS IN VOL. IX.

	PAGE
<i>Succinea Gimlettei</i> , n.sp.	10
<i>Limnea</i> (<i>Gulnaria</i>) <i>Schwilpi</i> , n.sp.	10
,, ,, <i>Lumleyi</i> , n.sp.	11
,, ,, <i>Sinensis</i> , n.sp.	11
<i>Humphreyia Strangei</i> , juv.	23, 24
<i>Thersites</i> (<i>Glyptorhagada</i>) <i>Hillieri</i> , n.sp.	26
Anatomy of <i>Neritidæ</i>	28, 29
<i>Lithasiopsis Hinkleyi</i> , operculum	47
<i>Lithasia obovata</i> , operculum	47
<i>Lithasiopsis Hinkleyi</i> , radula	48
,, ,, shell	49
,, <i>Mexicanus</i> , n.sp.	50
<i>Ennea Ansongei</i> , n.sp.	51
<i>Ennea Rosenbergiana</i> , n.sp.	52
<i>Thapsia innocens</i> , n.sp.	53
<i>Cerastus delicatula</i> , n.sp.	53
<i>Homorus Manueli</i> , n.sp.	54
<i>Pseudoglossula minuscula</i> , n.sp.	55
<i>Ampullaria alucinans</i> , n.sp.	63
<i>Ampullaria nigricans</i> , n.sp.	63
<i>Donovania fasciata</i> , n.sp.	65
<i>Pisania lirocincta</i> , n.sp.	66
<i>Phenacolepas mirabilis</i> , n.sp.	66
<i>Fissurella</i> (<i>Cremides</i>) <i>Keppeliana</i> , n.sp.	67
<i>Papuina rhodochila</i> , n.sp.	82
<i>Vivipara fragilis</i> , n.sp.	113
<i>Anodonta Becklesi</i> , n.sp. (Plate I.)	116
<i>Helix</i> sp.? Perhaps a hybrid	119
<i>Helicodonta Hispanica</i> , n.sp.	125
<i>Margaritana margaritifera</i> . (Plate II, distribution.)	145
<i>Voluta nodiplicata</i> , n.sp. (Plate III.)	146
<i>Latirus Ernesti</i> , n.sp.	147
<i>Cremnobates parva</i> , Swainson	152
<i>Ennea Roberti</i> , n.sp.	164
<i>Ennea Meneleki</i> , n.sp.	164
<i>Helicarion Hararensis</i> , n.sp.	165

	PAGE
<i>Helicella (Lejeania) Rosenbergi</i> and vars.	165
<i>Buliminus affinis</i> , n.sp.	166
<i>Achatina Ariel</i> , n.sp.	167
<i>Limicolaria Jickeliana</i> , n.sp.	167
<i>Homorus princeps</i> , n.sp.	168
<i>Homorus perlucida</i> , n.sp.	168
<i>Subulina (Itiopiana) Meneleki</i> , n.sp.	169
" " <i>vicina</i> , n.sp.	170
" " <i>nympha</i> , n.sp.	170
Pyramidellidæ from the Persian Gulf, etc. (Plates IV-VI.)	184, 194, 206
Anatomy of <i>Rhysota Foullioyi</i> . (Plates VII and VIII.)	208, 211
<i>Caducifer tessellatus</i> (Reeve), radula	227
<i>Melania Goramensis</i> , n.sp.	228
<i>Melania Stalkeri</i> , n.sp.	228
<i>Melania Keiensis</i> , n.sp.	229
<i>Pachychilus violacens</i> , n.sp.	230
Anatomy of <i>Psammobia</i> . (Plates IX and X.)	233, 239
<i>Cleopatra ferruginea</i> (Lea), animal	240
<i>Helicodonta Salteri</i> , n.sp.	268
Types of Lamarck's recent species of <i>Vulsella</i> . (Plate XI.)	312
<i>Phasianella Kraussi</i> , n.sp.	313
<i>Peristernia venusta</i> , n.sp.	316
<i>Nassa exulata</i> , n.sp.	317
<i>Cardium (Fragum) rubescens</i> , n.sp.	317
<i>Brachydontes (Hormomya) rufolineatus</i> , n.sp.	318
<i>Valvata Woodwardi</i> , n.sp.	324
<i>Sphærium Bulleni</i> , n.sp.	325
<i>Oxytes Beddomei</i> , n.sp.	327
<i>Oxytes Shanensis</i> , G.-A.	328
<i>Mitra biconica</i> , n.sp.	334
<i>Neptunea (Sipho) attenuata</i> (Jeffreys)	337
<i>Neptunea (Sipho) pertenuis</i> , n.sp.	340
<i>Buccinum oblitum</i> , n.sp.	343
<i>Conus Beckeri</i> , n.sp.	352
<i>Siphonaria Algesiræ</i> , Quoy	355
<i>Acmæa Bombayana</i> , n.sp. and var.	357
<i>Neocyclotus fonticulus</i> , n.sp.	359
<i>Choanopoma Rosenbergianum</i> , n.sp.	359
<i>Chondropoma Caymanense</i> , n.sp.	360
<i>Eurystrophe Filholi</i> (Bourguignat), n.gen.	362
Upper Tertiary lacustrine shells of the Island of Cos. (Plate XII.)	367

PROCEEDINGS

OF THE

MALACOLOGICAL SOCIETY OF LONDON.

ORDINARY MEETING.

FRIDAY, 12TH NOVEMBER, 1909.

B. B. WOODWARD, F.L.S., President, in the Chair.

The following communications were read:—

1. "Note on the identity of *Calliostoma Sowerbyi*, Pilsbry, with *C. haliarchus*, Melvill." By J. Cosmo Melvill, M.A.

2. "Notes on some species of Mollusca collected in China from 1904 to 1907, with descriptions of new species." By Staff-Surgeon K. H. Jones, R.N., and H. B. Preston, F.Z.S.

3. "Notes on the genus *Erato*, with a list of the known recent species." By E. A. Smith, I.S.O.

4. "On the occurrence in the British Isles of living specimens of *Pisidium Steenbuchii*, Mörch, and *P. Liljeborgii*, Clessin, with notes of new records of *Pisidia* for the Lake District, and fresh localities for *P. supinum*, A. Schm." By B. B. Woodward, F.L.S.

5. "Some remarks with regard to Professor Bourne's monograph on the Neritidæ." By Dr. H. Simroth.

6. "Note on *Sculptaria*." By J. H. Ponsonby, F.Z.S.

The President exhibited, on behalf of Mrs. Longstaff, specimens of a dark form of *Vitrea lucida* from Lyme Regis.

Mr. G. B. Sowerby exhibited *Cypræa annulus* with a pearl-like tubercle.

Mr. E. A. Smith exhibited, on behalf of Colonel Wilmer, a living sinistral specimen of *Helicella caperata* from Brighton Downs found by Colonel Wilmer;¹ *Trigonia* with abnormal hinge, the central tooth of the left valve being detached and having become soldered to the teeth of the opposite valve.

Mr. A. S. Kennard, a collection of Vitreas.

¹ Mr. J. W. Taylor kindly informs me that he has records of sinistral examples of this species from Cumberland, Yorkshire, Northampton, Sussex, and Devon.

ORDINARY MEETING.

FRIDAY, 10TH DECEMBER, 1909.

B. B. WOODWARD, F.L.S., President, in the Chair.

Mr. E. Latouche Armstrong was elected a member of the Society.

The following communications were read:—

1. "Note on the very young stage of the genus *Humphreyia*." By E. A. Smith, I.S.O.
2. "A further note on the anatomical differences between the genera *Cypræa* and *Trivia*." By H. O. N. Shaw, F.Z.S.
3. "Note on the references to certain groups, etc., used in the classification of Mollusca." By H. O. N. Shaw, F.Z.S.
4. "A new Mexican genus of Pleuroceratidæ." By Professor H. A. Pilsbry.
5. "Notes on a small collection of terrestrial shells from Angola, with descriptions of new species." By H. B. Preston, F.Z.S.
6. "Notes on the genus *Libera*." By J. H. Ponsonby, F.Z.S.

Mr. E. A. Smith exhibited an abnormal specimen of *Nautilus pompilius* from Ralum, in New Britain.

Mr. H. B. Preston exhibited photographs of the unique specimen of *Archytæa catenulata*, O. Costa, in the collection of the Reale Università di Naples.

The President exhibited a Japanese carving of an octopus with a diving woman, and drawings by Sir R. Owen, K.C.B., of a similar carving.

ORDINARY MEETING.

FRIDAY, 14TH JANUARY, 1910.

B. B. WOODWARD, F.L.S., President, in the Chair.

Miss Mary S. Johnstone, Mr. Charles Oldham, and Mons. Louis Germain were elected members of the Society.

Dr. Henry Woodward and Mr. R. Bullen Newton were appointed auditors for the accounts of the previous year.

The following communications were read:—

1. "Note on *Helix desertorum*, Forskål." By Mrs. G. B. Longstaff, F.L.S.
2. "Description of *Thersites* (*Glyptorhagada*) *Hillieri*, n.sp., from South Central Australia." By E. A. Smith, I.S.O.
3. "Note on the Egg-capsules of *Melo*." By E. A. Smith, I.S.O.
4. "Note on *Athoracophorus Schauinslandi*." By Henry Suter.
5. "Notes on the family Ampullariidæ." By G. B. Sowerby, F.L.S.
6. "Descriptions of new species of *Donovania*, *Pisania*, *Phenacolepas*, and *Fissurella*." By G. B. Sowerby, F.L.S.
7. "On Marine Mollusca from the Kermadec Islands, and on the '*Sinusigera apex*'." By Tom Iredale.

8. "Notes on *Polyplacophora*, chiefly Australasian." Part I. By Tom Iredale. (Publication deferred.)

9. "Notes on a collection of Helicoid Land Shells from New Guinea." By G. K. Gude, F.Z.S.

Mr. G. B. Sowerby exhibited a series of *Hinnites gigantea* in various stages of development, the young stages of this species being remarkably like *Pecten*, while the older and adult specimens distinctly showed the demarcation between the young free stage and the later fixed stage.

Mr. H. B. Preston exhibited the type of *Helicella cantianiformis* (Bourg.), Ancey, from Folkestone, which proved to be simply an abnormal specimen of *H. cantiana*, Mont.

The Rev. A. H. Cooke exhibited specimens of *Helix desertorum*, Forskål, collected by him six years previously, and which had been in a tin box without food for the whole of that period, until the previous day, when sixteen of these in various stages of growth were found to be alive, thereby beating the record of the famous specimen in the British Museum.¹

[¹ Specimens given to me by Mr. Cooke on his return from Egypt were placed in a glass-topped box in February, 1904, and labelled "To be opened in 1908, or later". Five of these specimens were placed in a glass jar upon moistened blotting-paper on 17th January, 1910, and one was found crawling about the following morning. I would here call attention to a circumstantial account of the revival of some snails after fifteen years' torpidity, given in the Phil. Trans., 1774, vol. lxiv, pt. ii, p. 432.—*E. A. Smith.*]

NOTES.

NOTE ON AN ABNORMAL SPECIMEN OF *NAUTILUS POMPILIUS*. (*Read 10th December, 1909.*)—This specimen is figured by Dr. Arthur Willey (*Zoological Results*, pt. vi, p. 812, fig. 15). It was given to him at Ralum in New Britain. It is divided into two nearly equal halves by a submedian groove, not unlike that in *Pleurotomaria*. The groove extends from the edge of the lip round the periphery of the shell and within the aperture as far as the eye can follow it. Dr. Willey observes: "I am unable to decide whether it was due to an injury to the mantle or to some congenital malformation."

I am of opinion, however, that it is due to an injury to the mantle, for I have seen in other specimens of *N. pompilius* similar grooves, but less pronounced, commencing at different places, and in one example three such grooves occur, two, about an inch apart, starting from the same growth-line, and the third about $2\frac{1}{2}$ inches nearer the lip of the shell. Such injuries to the mantle, resulting in these abnormalities, might easily be caused by the bite of a fish or the nip of a Crustacean.

Mr. G. C. Crick has shown me an almost similar abnormality in a specimen of the Eocene *N. Mokattamensis*, Foord, from Mokattam Range, near Cairo.

E. A. SMITH.

NOTE ON THE EGG-CAPSULES OF *MELO*. (*Read 14th January, 1910.*)—Mr. A. J. Jukes-Browne has very kindly placed in my hands some egg-capsules of a species of *Melo* from Dunk Island off the North Queensland coast, and as nothing appears to have been written upon the egg-stage of that genus the following few observations may be of some interest.

Although it has been stated by Gray¹ that the animal of *Melo* is oviparous, I have failed to discover the source of his information. On the contrary, the Messrs. H. & A. Adams² observe that "the animal of this genus appears to be ovo-viviparous, the same as *Cymbium* of Klein, the young ones being arranged in the oviduct of the female in a long string, without egg-shells". This statement is copied by Tryon,³ and it might also be inferred from what appears in Fischer's *Manuel de Conch.*, p. 606, that the animal is viviparous.

The observations, however, of Mr. J. Banfield, who collected the cluster of egg-capsules, part of which is now exhibited and described in a letter to Mr. Jukes-Browne, remove all doubt upon the matter. He himself has given some account of these capsules in his interesting book entitled *The Confessions of a Beachcomber*.

The mass of egg-cases was cast up on the shore attached to a piece of coral. It was $16\frac{1}{4}$ inches in length, $12\frac{3}{4}$ in circumference at one end, narrowing to 7 at the other. It weighed $1\frac{3}{4}$ lb., and consisted of 126 separate cells or capsules. These are conical in form, the rounded apices being free and turned inwards, the bases external and connected with one another, but not always completely, so that irregular openings occur

¹ Proc. Zool. Soc., 1855, p. 53; List of Mollusca, Brit. Mus. Volutidæ, p. 4; Guide to Moll. Brit. Mus. (1857), p. 33.

² Genera Moll., vol. i, p. 158.

³ Man. Conch., vol. iv, p. 80.

between them. In spirit they are tough and cartilaginous, rather over an inch long and about the same in their greatest width at the base, and each contains only a single embryo.

The shells when extracted from the capsules are an inch in length, consist of $5\frac{1}{2}$ whorls, the last showing the commencement of the colour-markings and the columellar plaits of the adult shell.

Since the above was written Mr. Jukes-Browne has received from Mr. Banfield a photograph of a more complete mass of egg-capsules. It has very much the form of an elongate fir-cone, and the openings in it appear to be arranged in longitudinal, slightly oblique, and regular rows, the lower margin of each opening exhibiting a short spike-like projection which is the termination of a ridge upon one side of the capsules.

E. A. SMITH.

NOTE ON FEEDING OF *HELIX DESERTORUM*, FORSK., IN CAPTIVITY. (Read 14th January, 1910.)—Specimens of this snail were taken on 3rd January, 1909, near the Gizeh Pyramids, where, except one individual found on a stone covered with lichen, none were seen far from the traces of higher vegetation, at that time dried up. Three examples were kept alive at Mortehoe in Devon from the first week in May till 12th September of the same year, when they died seemingly from excess of moisture in the air and their food, which was principally lettuce. They ate sparingly of the leaf of cauliflower and of a bean, and consumed with avidity the petals of a Niphetos rose, but did not appear to care for those of other species. They liked the petals of calceolaria, and ate those of pink carnations, but not those of the red. They were further offered petals and leaves of borage and balsam, petals of *Schizanthus*, leaves of celery, sedum, saxifrages, turnip, strawberry, *Potentilla*, dandelion, and spinach, but did not care for any of them.

MRS. G. B. LONGSTAFF, F.L.S.

ON THE OCCURRENCE IN THE BRITISH ISLES OF LIVING SPECIMENS OF *PISIDIUM STEENBUCHII*, MÖRCH, AND *P. LILLJEBORGII*, CLESSIN, WITH NOTES OF NEW RECORDS OF *PISIDIA* FOR THE LAKE DISTRICT, AND FRESH LOCALITIES FOR *P. SUPINUM*, A. SCHM. (Read 12th November, 1909.)—A short time since Mr. F. F. Laidlaw forwarded for determination some specimens of *Pisidium* from Lochan a' Chait, a small tarn situated to the north of Loch Tay on the flanks of Ben Lawers, Perthshire, at an elevation of 2250 feet. These proved to be examples of *P. Steenbuchii*, Mörch, a northern form, which had hitherto only been found fossil in these islands. Thus it had been recognized in Holocene deposits at Shand Street, Tooley Street (Surrey), Gayfield (Edinburgh), and in a Shell Marl at Inchiquin (co. Clare, Ireland); whilst in the Pleistocene it occurs in the Crayford-Erith shell-beds, and in the freshwater beds of the Forest Bed at West Runton (Norfolk).

A little later Mrs. Longstaff sent me some *Pisidia* from the Lake District. These included examples of an oval form of *P. Steenbuchii* from Abbey Holme in Cumberland, and Patterdale on the borders of Westmorland, that had been collected twenty-five years ago.

The following species in her collection were also new, in name at least, to the district, viz.:—*Pisidium subtruncatum* from Blaithwaite and near Carlisle, *P. obtusale* from Dalston and Wreay, and *P. personatum* from Rockcliffe. The last-named species has also been received from Captain W. J. Farrer, from Bassenthwaite Lake, whilst the same observer has collected from ditches thereabout *P. pulchellum*, another new record for the Cumberland fauna.

From Mr. Stellfox, through Mr. Kennard, specimens of great interest have been received from Lough Aguse, co. Fermanagh, Ireland (alt. 450 feet). After very careful comparison it would seem that these are British representatives of the Swedish species *P. Lilljeborgii*, Clessin, a form closely allied to, but apparently distinct from, both *P. obtusale* and *P. Steenbuchii*. There are at present, it is true, only four specimens; still, though more globose than my Norwegian specimens, there cannot, I think, be any doubt as to their identity.

Of the fifteen living forms of *Pisidium* known to me from North-Western Europe, fourteen have, therefore, now been met with in these islands. One only, the little *P. parvulum*, Clessin, a Scandinavian species, about the size of a big pin's head, has not yet been reported. Since, however, like *P. supinum*, it has a relatively strong hinge, it may be looked for in running waters among sand, in upland streams, where it has quite possibly been overlooked.

By way of supplement to the note on the distribution of *P. supinum* in Britain, that was read at the May meeting of this Society (Proc. Malac. Soc., vol. viii, p. 330), the following further localities for this species may now be enumerated. From Budworth Mere, Cheshire, Mr. A. S. Kennard has received a single pair of fine valves. During the summer Mr. C. Oldham traced the species along the Grand Junction Canal, obtaining it from Rickmansworth and Tring in Hertfordshire, Marsworth in Bucks, and sparingly at Blisworth in Northamptonshire. Mr. J. E. Cooper has found the species sparsely in mud in a stream at Iver (Bucks) and at Byfleet (Surrey); specimens have just been forwarded by Mr. H. C. Napier from rejectamenta of the Cherwell at Mesopotamia, Oxford; whilst Mr. H. Overton has taken it in the Severn at Bewdley.

B. B. WOODWARD.

NOTE ON *ATHORACOPHORUS SCHAUINSLANDI*. (Read 14th January, 1910.)—Quite recently it has been my good fortune to obtain, through the kindness of Mr. T. H. Turner, Stephens Island, live specimens of *Athoracophorus Schauinslandi*, Plate, and I am now able to supply the following additional information.

The living animal has a lanceolate, depressed convex body when at rest, and a full-grown specimen showed the following dimensions: length 37, breadth 15, height 6 mm. When crawling the animal was not much higher, but more narrowed, and longitudinally extended, the length being 55, breadth 10 mm. Colour yellowish-brown, with the minute granules of the notum black; the large papillæ, which usually only appear through contraction when preserved in alcohol, are marked by whitish spots surrounded by black; mantle-area yellowish, margined with black; tentacles greyish. The latter are rather short, slightly clavate, with an annular swelling at the base, 3 to 4 mm. long when fully extended. Notum minutely and densely granular all over; the large papillæ are sometimes sharply raised, but after a short period their turgidity disappears, and the whole dorsum is left only minutely granular. The grooves are distinct, and the median furrow of the head-shield is always distinct. The specimens at the disposal of Professor Plate had no median groove on the head-shield, no doubt as a result of the mode of preservation. All the living specimens I examined had this median groove very distinct.

The eggs are laid in clusters of twenty to thirty; they are yellowish-white, semi-transparent, globular or slightly oval, the surface distinctly puckered; diam. 3 mm.

H. SUTER.

NOTE ON THE IDENTITY OF *CALLIOSTOMA SOWERBYI*, PILSBRY,
WITH *C. HALIARCHUS*, MELVILL.

By JAMES COSMO MELVILL, F.L.S.

Read 12th November, 1909.

IN 1878 Mr. G. B. Sowerby described¹ a then unique member of the Trochidæ, from Japan, under the name *Zizyphinus jucundus*. It was a fairly smooth shell, finely granolirate on the uppermost whorls, the succeeding ones, as well as the body-whorl, being almost smooth, with the exception of granoliration at the sutures, the aperture obliquely quadrate, mouth pearly. Alt. 30, diam. 33 mm.

In January, 1889, the description² of *Zizyphinus haliarchus*, mihi, was published, the type being an unique shell lately presented to the Manchester Museum, Owens College (now the Victoria University of Manchester), by the executors of the late Mr. Reginald Cholmondeley, of Condover Hall, Shrewsbury, together with many other rare and valuable specimens. This fine shell was differentiated from *Z. jucundus*, Sowb., by certain characters, such as greater inflation, tenuity of substance, size (alt. 40, diam. 36 mm.), etc. It was also reported, with some queried element of doubt, to have been dredged in deep water off the eastern coasts of Australia.

Now, Dr. Gould had, in 1849, already published a *Zizyphinus* under the name of *Trochus jucundus*, and, accordingly, when working on his able monograph of the Trochidæ, Dr. H. A. Pilsbry, finding it thus necessary to change the name of Sowerby's shell, prepared for it the appellation *Sowerbyi*, by which it has been since known.

Quite recently, I received from Mr. Sowerby a specimen labelled "*Calliostoma Sowerbyi*, Pils.", and I at once recognized it as identical with *C. haliarchus*. The following week I was able, in company with Mr. R. Standen, to compare it with the type, when my impressions were confirmed, it differing in not much else except size. This proves conclusively how often erroneous conclusions may be drawn from only reading a description, or comparing a figure, however well executed, when one is not able to examine the type.

I placed the matter before Mr. Sowerby, who kindly at once gave me his opinion upon the subject, which was that both his name *jucundus* must yield to Dr. Gould's, and *Sowerbyi*, Pilsbry, to *haliarchus*, Melv., for, though both the latter appellations were bestowed in 1889, *haliarchus* was published 1st January, while *Sowerbyi* appeared in the fourth instalment (out of five) of vol. xi of the Manual, and therefore was published after 1st August.

¹ Proc. Zool. Soc., 1878, p. 798, pl. xlviii, fig. 6.

² Journ. of Conch. published January 1, 1889, vol. vi, p. 32, pl. ii, fig. 3.

The synonymy, therefore, will stand as follows:—

CALLIOSTOMA HALIARCHUS (Melv.).

Zizyphinus jucundus, Sowerby, Proc. Zool. Soc. Lond., 1878, p. 798, pl. xlviii, fig. 6 (*non* Gould, 1849).

Z. haliarchus, Melvill, Journ. of Conch., vol. vi, p. 32, pl. ii, fig. 3 (January 1, 1889).

Calliostoma Sowerbyi, Pilsbry, Man. Conch., 1889, vol. xi, pt. iv, p. 352.

Hab.—Japan, and perhaps East Australia.

NOTES ON SOME SPECIES OF MOLLUSCA COLLECTED IN CHINA
FROM 1904 TO 1907, WITH DESCRIPTIONS OF NEW SPECIES.

By Staff-Surgeon KENNETH H. JONES, R.N., and H. B. PRESTON, F.Z.S.

Read 12th November, 1909.

THE majority of the species referred to in this communication were collected by Staff-Surgeon K. H. Jones at Hong-Kong and Wei-hai-wei between the years 1905 and 1907, but those from Shi Tao, in the province of Shantung, were obtained by the late Mr. C. A. Schwilp, who resided at that place. The species from Wei-hai-wei include four which were not observed there in 1901-2, and one of these at any rate, *Eulota (Cathaica) fasciola*, Drap., has probably been introduced since that time, perhaps from Shanghai, where it is fairly common. This species is very conspicuous and not at all likely to be overlooked. The remarkably local distribution of many species as noticed in our former paper¹ is again borne in upon us. Many species are here noted, on account of the localities in which they were found, in evidence of their area of distribution.

HELICARION IMPERATOR, Gould.

Of this common Hong-Kong species a specimen was taken at Little Hong-Kong Wood in 1906, which instead of being of the usual reddish horn colour was of a distinct greenish hue. This is the only shell of this species so coloured which was observed at Hong-Kong.

EULOTA (CATHAICA) FASCIOLA (Drap.).

This species, there is little doubt, has been introduced into Wei-hai-wei since 1902, perhaps from Shanghai, with which port there is constant communication, especially during the summer months, but possibly from Tien-tsin to the north, or even from the mainland opposite. This is not a species which is easily overlooked, and it was not observed on the mainland of Shantung. On the island of Wei-hai-wei it is confined to the residential portion, over which it is rapidly spreading, being particularly partial to gardens and their walls. The specimens are of fair size, and all of them present one band on the body-whorl with the exception of two, in one of which there are two bands and the other is bandless. One immature sinistral specimen was obtained.

SUCCINEA SINENSIS, Gray.

It is of interest to note that this species is commonly enough found at Hong-Kong in different parts of the island and at various altitudes, but always in flower-pots. Although often to be seen wandering away from the pots in which they live, they do not seem able to establish themselves elsewhere. Probably the species

¹ Proc. Malac. Soc., vol. vi, pp. 130-51.

has been introduced in flower-pots from the neighbourhood of Canton. One specimen was taken in which the shell was a pale greenish-white, the animal being of a normal colour.

Succinea Gimlettei, n.sp.

Differs from *Succinea Sinensis*, Gray, by its narrower form and more elevated spire, much darker colour, broader penultimate whorl, and shorter and less dilated aperture. Alt. 9.75, diam. maj. 5.5 mm. Aperture, alt. 5.5, diam. 3.5 mm.



Hab.—Wei-hai-wei Island, N.E. China.

This species has probably been introduced into Wei-hai-wei Island, perhaps from Tien-tsin, or even from the opposite mainland. Specimens are very numerous in the courtyards of a few ruined houses above and to the east of the naval sick-quarters. Unlike *Succinea Sinensis* it has not been noticed in flower-pots.

Limnea (Gulnaria) Schwilpi, n.sp.

Shell oblong-ovate, subperforate, pale reddish horn colour, whorls 4, the first two much eroded, the lower marked with transverse growth-lines, and presenting a slightly malleated appearance, the penultimate whorl moderately convex, the last whorl considerably inflated; sutures well impressed, faintly crenulate; columella



descending very obliquely, much twisted, outwardly expanded, and extending into a thickish callus, which reaches the lip above; peristome acute, slightly reflexed below, simple above; aperture broadly inversely auriform, dilated below. Alt. 23.5, diam. maj. 13 mm. Aperture, alt. 16.5, diam. maj. 9.5 mm.

Hab.—Shi Tao, Shantung, N.E. China.

Confined, like so many other species in this part of China, to one piece of water.

Limnea (Gulnaria) Lumleyi, n.sp.

Shell ovate, contracted below, scarcely perforate, semi-transparent, pale reddish horn colour; whorls 4, the first three very small in

proportion to the last, last whorl showing traces of very minute spiral striae, and sculptured with transverse growth-lines; sutures impressed; columella iridescent, descending obliquely, scarcely twisted, diffused above into an almost imperceptible, thin callus; peristome acute; aperture ovate. Alt. 13, diam. maj. 8 mm. Aperture, alt. 9, diam. 5 mm.



Hab.—Wei-hai-wei Island, N.E. China.

Differing from *L. Schwilpi* chiefly by its much smaller size and by the columella, which, being scarcely twisted and not nearly so oblique, is not expanded into the very thick callus of that form; the aperture is also more ovate and much less auriform in shape. This species appears to be confined to a very shallow and narrow gutter or ditch which runs along the side of the road leading to the Golf Links.

LIMNEA (GULNARIA) SINENSIS, n.sp.

Shell ovate, subrimate, semi-transparent, rather glossy, pale greyish-yellow horn colour; whorls 5, rapidly increasing, the first two very acuminate, the last swollen and dilated, sculptured with lines of growth and distant spiral scratch-like striae; sutures well impressed;



columella vitreous, excavated below, diffused above into a moderately thick dilated callus which joins the lip above; peristome acute, simple; aperture broadly dilated, ovate. Alt. 23.5, diam. maj. 15 mm. Aperture, alt. 17, diam. 10 mm.

Hab.—Shi Tao, Shantung Province, N.E. China.

Confined to a limited area like most species of the genus in China.

VIVIPARA CHINENSIS, Gray.

This common Chinese species was obtained at Shi Tao, and as it has been noticed in our previous paper as occurring at the Chusan Islands and about Hong-Kong, it has a considerable distribution north and south. Like the previous species it appeared to be closely

confined to one particular locality. The shells are much browner, and not so large as those found further south.

VIVIPARA SUBANGULARIS, Von Martens.

This species was found in enormous numbers, but entirely confined to two small ponds on the golf-links of Wei-hai-wei Island. The two ponds were quite shallow, and divided from each other by a few feet of earth only; in size they may have been 40 feet square. Although there are sundry other ponds on this small island, apparently quite as capable of supporting colonies of *Viviparæ*, they do not contain a single individual. We think this species has been recently introduced. We do not know whether it has occurred so far north before, and it was originally described from the Chusan Islands.

TURBO (MARMOROSTOMA) CORONATUM, Desh.

A common species upon the rocks at Shi Tao in Shantung.

CHLOROSTOMA RUSTICUM (Gmel.).

Hab.—Shi Tao, Shantung, N.E. China.

ACMÆA CONCINNA, Lischke.

A fairly common shell on the rocks by the seashore at Shi Tao in Shantung.

TAPES SEMIDECUSSATUS, Desh.

A few specimens from Shi Tao in Shantung.

CORBICULA FLUMINEA (Müll.).

A few specimens were obtained at Shi Tao in the province of Shantung.

NOTES ON THE GENUS *ERATO*, WITH A LIST OF THE KNOWN
RECENT SPECIES.

By EDGAR A. SMITH, I.S.O.

Read 12th November, 1909.

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THE genus *Erato* has been monographed several times, and consisting of such small shells, mostly without any very striking features, it is not surprising that various errors of identification have occurred. The object of the present paper is an endeavour to clear up such mistakes, and to bring the list of species up to date. Having the Cuming Collection in the Museum I am in a position to offer some criticism upon the monographs by Sowerby and Reeve, as both were based upon that collection. The following is a list of the monographs and catalogues of species:—

- 1832. Gray: Descriptive Catalogue of Shells, *Cypræidæ*, pp. 16–17, no figures. Printed, but not published, *fide* C. Davies Sherborn.
- 1837. Sowerby, sen. (*a*): Conch. Illust., *Cypræadæ*, pp. 16–18, figd.
- 1842. Reeve (*a*): Conch. System, vol. ii, pp. 259–61, pl. 285.
- 1859. Sowerby, jun. (*b*): Thesaurus Conch., vol. iii, pp. 81–4, pl. 219.
- 1865. Reeve (*b*): Conch. Icon., vol. xv, three plates.
- 1870. Redfield: Amer. Journ. Conch., vol. vi, Appendix, pp. 216–20. A synonymic list of species.
- 1879. Weinkauff: Conchyl. Cabinet, *Marginella* and *Erato*, pp. 145–56, pls. xxv, xxvi.
- 1880. Weinkauff: Jahrbüch. deutsch. Malak. Ges., 1880, vol. vii, pp. 107–8. List of known species.
- 1883. Tryon: Manual Conch., vol. v, pp. 7–12, 197–8, pl. iv.

In the following list the above references will not be given in full, but merely quoted under the authors' names. The monograph by Gray, according to Mr. C. Davies Sherborn, exists only in a few proof-sheets printed in 1832, but never issued as a publication. It is quoted, however, by Redfield, who evidently must have had access to the work, for he could not have copied the references, since they do not appear in any previous monograph.

If, therefore, Gray's monograph be disregarded, it becomes necessary to assign another author to the species described in his unpublished work. Sowerby in his Conch. Illust. adopted all the four new species founded by Gray, giving him the credit of their authorship. Under these circumstances perhaps it would be advisable to allow Gray's name to be quoted, since this has been done in all subsequent works.

1. ERATO LÆVIS (DONOVAN).

(For references and synonymy see Redfield, p. 217.)

SYN. *Erato callosa*, Reeve (*b*), (*non* Adams & Reeve), figs. 2*a-b*.Perhaps *E.* (?) *Maugeria*, var. *Panamensis*, Carpenter, Proc. Zool. Soc., 1856, p. 162.= *T. sulcifera*, Sowerby (*b*), *partim* (*non* Gray), p. 81, pl. 219, fig. 3.= *T. Maugeria*, Reeve (*b*), figs. 10*a-b*.*Hab.*—Coasts of Great Britain, France, Spain, Mediterranean; Oran (Pallary for var. *minor*, 6 mm. long¹).

Beyond a difference in size it is difficult to find any distinguishing features between this species and the West Indian *E. Maugera*. It is subject to great variation in size, and among a number of specimens from Salcomb Bay, Devon, I find the largest to be 10 mm. in length, whereas the smallest is only 6. *E. Maugera* is perhaps more shortly pyriform, and at the upper part of the columella a small tubercle is generally observable, which does not occur, or is less noticeable, in *E. lævis*. The shells described by Carpenter as *E. Maugeria* (?), var. *Panamensis*, figured by Reeve as *Maugeria*, might with equal propriety be regarded as a variety of the present species, which they resemble so closely that one only hesitates to name them *E. lævis* because of the locality from which they are said to have come. One of the three shells described by Carpenter has been figured by Sowerby as a *E. sulcifera*, Gray, a much smaller granose shell which occurs at the Mauritius and elsewhere in the East. Reeve also has figured a small example of *E. lævis* as *E. callosa*, Ad. & Reeve, which is easily separated by the narrower aperture, excavated columella, and more finely denticulated labrum.

2. ERATO MAUGERÆ (Gray), Sowerby.

Erato Maugera, Gray, p. 17.*E. Maugeria*, Sowerby (*a*), p. 17, pl. vii, fig. 47; id. (*b*), p. 83, pl. 219, figs. 7-9.*E. Maugeria*, Reeve (*a*), p. 260, pl. 285, fig. 4.*E. Maugeria*, Weinkauff, p. 150, pl. xxv, figs. 13, 16.*E. Maugeria*, Tryon, p. 9, pl. iv, figs. 42, 43.*Hab.*—West Indies and Florida.

Never so large as *E. lævis*, otherwise very similar. It is sometimes pale flesh colour, or it may be olivaceous.

3. ERATO PRAYENSIS, Rochebrune.

Erato Prayensis, Rochebrune, Bull. Soc. Philom., 1881, vol. vi, p. 30;id., Nouv. Archiv. Mus., 1881, vol. iv, p. 294, pl. xvii, figs. 16*a-b*.*Hab.*—Porto-Praya, Cape Verd Islands.

I do not find anything in the brief description of this species to distinguish it from the West Indian *E. Maugera*. Nor does the

¹ Journ. de Conch., 1900, vol. xlviii, p. 307.

figure, which is evidently badly drawn, assist in its determination. However, not having seen specimens from the Cape Verde Islands, I hesitate to give an opinion upon the identity of this shell with *Maugeræ*. M. Germain kindly informs me that he has been unable to find this species in the Paris Museum, and that Dr. Rochebrune does not know where the specimens are which he described.

4. *ERATO MARGINATA*, Mörch.

Erato marginata, Mörch, Malak. Blätt., 1860, vol. vii, p. 85.

Hab.—Bocorones Island, near Panama.

Briefly described and unfigured. Colour not stated. Considered by Tryon probably the same as *E. columbella*. In my opinion it may be the same as *E. Maugeræ*. On inquiry of Dr. Levinsen, of the Copenhagen Museum, he writes: "We cannot find *Erato marginata* either in our collection or in our registers."

5. *ERATO COLUMBELLA*, Menke.

Erato columbella, Menke, Zeitschr. f. Malak., 1847, p. 183; Sowerby (*b*), p. 83, figs. 31, 32; Reeve (*b*), figs. 1*a*–*b*; Weinkauff, p. 148, pl. xxv, figs. 9, 12 (9 bad); Tryon, p. 10, pl. iv, fig. 48 (after Sowerby).

E. leucophæa, Gould, Boston Journ. Nat. Hist., vol. vi, p. 386, pl. xiv, fig. 20; Otia, p. 187.

Hab.—Mazatlan (Menke); Santa Barbara (Gould); San Diego (Gripp and M. Smith); Monterey Bay (Berry).

I have placed *E. leucophæa* as a synonym of this species on the authority of Carpenter, Tryon, and others. Both the figure and description offer some points of difference.

6. *ERATO VITELLINA*, Hinds.

Erato vitellina, Hinds, Zool. Sulphur, p. 46, pl. xiii, figs. 22, 23; Sowerby (*b*), p. 83, figs. 27, 28; Reeve (*b*), figs. 3*a*–*b*; Weinkauff, p. 148, pl. xxv, figs. 6, 7; Tryon, p. 10, pl. iv, figs. 49, 50.

Hab.—California, Santa Barbara southward; San Diego (Gripp and M. Smith); Monterey Bay (Berry).

The largest species of the genus, and, like the rest, very variable in size, varying from 10 to 15 mm. in length. Mr. Joseph Keep, in his little book on "West American Shells", calls this species the "Veally Erato", but it seems to me that Reeve's designation of the species, the "Yolk Erato", is preferable. I fail to see that this shell has any connexion with veal or a young calf.

7. *ERATO ALBESCENS*, Dall.

Erato albescens, Dall, Nautilus, 1905, vol. xviii, p. 124.

Hab.—Deep water off Californian coast.

Length of shell, 15 mm. "This succeeds *E. vitellina*, Hinds, as the largest species of the genus, and is a much thinner and lighter shell, besides differing in colour" (Dall).

8. ERATO SCABRIUSCULA (Gray), Sowerby.

Erato scabriuscula, Gray, p. 16; Sowerby (a), p. 16, fig. 45; id. (b), p. 81, figs. 14–16; Reeve (b), figs. 4a–b; Weinkauff, p. 149, pl. xxv, figs. 10, 11; Tryon, p. 11, pl. iv, fig. 56 (after Reeve).

Marginella cypræola, Sowerby, Proc. Zool. Soc., 1832, p. 57; name preoccupied by Brocchi for a fossil (= *lævis*).

Marginella granum, Kiener, Coq. Viv., p. 17, pl. viii, fig. 33; Chenu's Illust. Conch., vol. iv, pl. iii, figs. 17, 17a; Chenu, Man. Conch., vol. i, p. 200, fig. 1067.

Hab.—St. Elena and Acapulco (Sowb.); Panama (C. B. Adams); Mazatlan (Jewett); west coast Central America to Mazatlan (Tryon).

The specific name *Cypræola*, suggested by Sowerby in 1832, had previously been employed by Brocchi for a fossil species (said to be the same as *E. lævis*) under the genus *Voluta*.

9. ERATO DENTICULATA, Pritchard & Gatliff.

Erato denticulata, P. & G., Proc. R. Soc. Victoria, 1900, vol. xii, p. 188; vol. xiii, p. 133, pl. xx, fig. 5.

Hab.—Victoria, Southern Australia.

I do not think it necessary to add anything to the author's admirable description of this species. In form it resembles in miniature some specimens of the British *E. lævis*, but of course is well distinguished by difference of coloration, more numerous labral denticulation, etc. It differs from *E. lachryma* (with which it has been united by Tate and May¹) and its varieties, in form, slightly wider aperture, rather less thickened labrum, finer and more marginal denticulation. The style of coloration is like that of typical *lachryma*, but much less pronounced.

10. ERATO OLIVARIA, Melvill.

Erato olivaria, Melvill, Ann. Mag. Nat. Hist., 1899, vol. iv, p. 91, pl. i, fig. 9.

Hab.—Karachi.

The whorls are described by Mr. Melvill as four in number, "supernis interdum rugosulis." This doubtless has reference to some curious oblique raised lines which pass over the spire on to the body-whorl. Whether this is a constant feature is uncertain, as I have only examined the type in the Museum. The colour of this shell is olive excepting the white thickened labrum and the anterior extremity of the body-whorl, and a pale line marks the suture. The denticles within the outer lip are rather strong, and only twelve in number in the type, not fifteen as stated in the original description.

Mr. Melvill observes that "the only other known smooth species of a uniform green or olive hue is *E. Prayensis*, Rochebrune, from the Cape Verde Islands". Such, however, is not the case, for I have seen numerous examples of *Maugera* of a distinctly olive or greenish colour, and some specimens of *E. lachryma* and *E. columbella* are more or less

¹ Proc. Linn. Soc. N.S.W., 1901, vol. xxvi, p. 375.

of the same tint. The denticles on the columella of *E. olivaria* are not very distinct. They are eleven or twelve in number, two or three about the middle being almost obsolete.

11. *ERATO LACHRYMA* (Gray), Sowerby.

Erato lachryma, Gray, p. 17; Sowerby (*a*), p. 17, fig. 48.

Hab.—New South Wales (Sowerby); New Holland (Gray); Queensland (J. E. Cooper in Brit. Mus.); Mast Head Reef, Capricorn Group, Queensland (Hedley); Sunday Island, Kermadec Group (T. Iredale).

The only figure at all resembling this species is the one quoted above. Those in the Thesaurus (figs. 4–6) and Conch. Icon. (figs. 9*a*–*b*) represent examples of the var. *callosa*, and the figures given by Weinkauff (pl. xxvi, figs. 9–10) are very unsatisfactory, both as regards colour and the denticulation of the outer lip.

The description given by Gray of the colour, “white, with three bright crimson cross bands,” or that of Sowerby, “whitish, with three red transverse bands,” correctly indicates the coloration of the typical form of this species, which apparently is restricted to East Australia. The apical whorls are generally yellowish olive or amber, and the anterior tip of the body-whorl is also stained with pale olivaceous brown. The three red bands are most distinct dorsally, the uppermost at the upper part of the body-whorl being the broadest, and the intermediate one is just below the middle. They do not extend on to the labrum. On the ventral side the uppermost one is the most apparent, the lowermost is less pronounced, and the central one is almost obsolete. The labrum has from twenty to twenty-two denticles in the largest specimens, and rather fewer in smaller ones. At the anterior end of the columella there are four or five transverse denticles, but the upper part is quite smooth.

Var. *CALLOSA*, A. Adams & Reeve.

Erato callosa, Ad. & Reeve., Samarang, Moll., p. 25, pl. x, figs. 32*a*–*b*; Sowerby (*b*), p. 82, figs. 35–7; Tryon, p. 9, pl. iv, figs. 38, 39 (after Sowerby); pl. ii, fig. 7, radula (after Troschel, Gebiss Schneck., vol. i, p. 216, pl. xviii, fig. 5).

E. sulcifera, Sowerby & Reeve (*non* Gray), Sowerby (*b*), p. 81, figs. 1–3; Reeve (*b*), figs. 14*a*–*b*.

E. guttata, Sowerby (*b*), p. 82, figs. 29, 30; Reeve (*b*), fig. 15.

E. lachryma, Sowerby & Reeve (*non* Gray), Sowerby (*b*), p. 82, figs. 4–6; Reeve (*b*), figs. 9*a*–*b*.

Hab.—China Sea (Ad. & Reeve.); Japan (Lischke, Dunker, Pilsbry, Brit. Mus.); Mauritius (Sowerby).

This variety differs from the typical form only in colour. Lischke, in his most excellent work, *Japan. Meeres-Conch.*, pt. ii, p. 68, notices the closeness of *E. lachryma* of Sowerby & Reeve with the present variety. This misidentification of the two English authors doubtless also led Pilsbry to quote the *E. lachryma* as Japanese (Cat. Marine Moll. Japan, 1895, p. 52).

The *E. callosa* of Reeve¹ I have already shown to be a small example of *E. levis*. I have not quoted Weinkauff's figures (pl. xxv, figs. 2, 3), as they do not represent the form of the true *callosa*, perhaps the artist's fault, being too broad at the shoulder, and the aperture, described in the text "*latiuscula*", is too broad anteriorly. On the contrary, the mouth in this species is narrow, linear, and not at all dilated in front.

The typical colour is described as "*carnea, subtus albicante*", but some specimens are olivaceous dorsally, interrupted with a pale line at the shoulder.

A feature which is fairly constant is a pale-brown edge to the anterior canal. As in other species of the genus there is considerable variation in the size of specimens. Large examples are 7 mm. in length, whilst some small ones are only $4\frac{1}{2}$ mm.

Under *E. sulcifera* I have shown that Reeve's and Sowerby's identification of that species was erroneous, and that the shells depicted by them were in fact worn examples of the present species.

Var. RECONDITA, Melvill & Standen.

Erato recondita, M. & St., Ann. Mag. Nat. Hist., 1903, vol. xii, p. 302, pl. xxi, figs. 9, 10.

Hab.—Gulf of Oman, 156 fathoms (M. & St.); China (Brit. Mus.).

There is very little to distinguish this variety from the var. *callosa* excepting the entire absence of colour, and the labrum is perhaps a little more produced behind. The number of denticles upon it is the same, about twenty to twenty-two, the columella is indistinctly denticulate in the same manner, and the whorl within the crenate edge is similarly excavated ("*Columella excavata*," Ad. & Rve.). No mention is made by Melvill & Standen of the columellar denticulation, but, although indistinct, about twenty faint denticles are observable in one specimen under a strong lens. A few upon the anterior end are quite distinct. The var. *haplochila* I regard merely as an undeveloped young shell, and although described as having a simple non-denticulate labrum, fine incipient denticles are present in the type-specimen, as shown in the figure (fig. 10). The number of labral denticles in fig. 9 is considerably exaggerated. Four specimens from China lately added to the Museum collection agree in all respects with those from the Gulf of Oman. They have the appearance also of being from deep water.

12. ERATO SANDWICHENSIS, Pease (emend.).

Erato Sandwichensis, Pease, Proc. Zool. Soc., 1860, p. 146; Reeve (*b*), figs. 17*a-b*; Tryon, p. 9, pl. iv, fig. 35 (after Sowerby).

E. Sandwichensis, Sowerby (*b*), p. 82, figs. 21, 22; Weinkauff, p. 154, pl. xxvi, figs. 14, 15 (after Reeve); Martens & Langkavel, Donum Bismarck, p. 20, pl. i, figs. 13*a-b* (bad).

Hab.—Sandwich Islands.

¹ Lischke, loc. cit., also remarks upon the difference between Reeve's shell and the true *callosa*.

Only four worn specimens have been examined. In this condition they are smooth, and do not show any signs of granulation. It is of narrow form like typical *sulcifera*, and like that species has a very narrow aperture. The labral denticles are close-set, and from twenty-two to twenty-four in number. The lower or anterior end of the columella is distinctly denticulate, but further up the denticles become very minute, and gradually obsolete posteriorly. The colour is accurately described by Pease, but Sowerby's "pallide rosea" is purely imaginary, and his figure, tinted a delicate pink, is equally misleading. The figure given by Reeve and copied by Weinkauff is fairly good. It is very closely allied to *E. lachryma*, but may be a trifle more slender, has a slightly narrower aperture, and the rosy tint of the apex and anterior extremity is peculiar. Largest specimen $5\frac{1}{2}$ mm. in length, 3 mm. in diameter.

13. *ERATO BIMACULATA*, Tate.

Erato bimaculata, Tate, Trans. and Proc. Phil. Soc. Adelaide, 1877-8, p. 88; Tate & May, Proc. Linn. Soc. N.S.W., vol. xxvi, p. 375, pl. xx, fig. 5.

Hab.—St. Vincent's Gulf, Spencer's Gulf, South Australia (Tate); Tasmania, N.W. Coast (Tate & May).

The figure above quoted is not of much use beyond giving some idea of the general form of the species. The characteristic rosy spots at both ends are very striking, and at once distinguish this species from the rest. The columella is said by Tate to have "eight crowded transverse plaits". It may, however, be crenulated the whole length, the denticulation at and above the middle being very minute. Within this the whorl is broadly and deeply excavated.

14. *ERATO SULCIFERA* (Gray), Sowerby.

Erato sulcifera, Gray, p. 16; Sowerby (*a*), p. 17, fig. 46; Tryon, p. 11, pl. iv, fig. 51 (copy of Sowerby).

Ovulum corrugatum, Hinds, Voy. Sulphur, Mollusca, 1844, p. 47, pl. xvi, figs. 5, 6.

E. corrugata, Sowerby (*b*), 1859, p. 82, pl. 219, figs. 10, 11; Weinkauff, p. 152, pl. xxvi, figs. 5, 6 (bad, useless); Tryon, p. 11, pl. iv, fig. 52 (copy of Sowerby).

E. nana (Duclos), Sowerby (*b*), p. 82, pl. 219, figs. 12, 18; Reeve (*b*), fig. 18 (bad); Tryon, vol. v, p. 11, pl. iv, fig. 53 (after Sowerby); Weinkauff, p. 155, pl. xxvi, fig. 16 (after Reeve).

E. Schmeltziana, Crosse, Journ. de Conch., 1867, vol. xv, p. 301, pl. xi, fig. 5; Weinkauff, p. 152, pl. xxvi, figs. 7, 8 (bad); Tryon, p. 11, pl. iv, figs. 54, 55 (after Crosse, but badly coloured).

Hab.—Cape of Good Hope (Sowb.); Durban and Port Shepstone (H. Burnup); Zanzibar, Mauritius, Seychelles, Amirantes (Brit. Mus.); New Guinea (Hinds for *corrugata*); Mindoro, Philippines (Sowb. for *corrugata*); Port Jackson (Angas for *corrugata*); Fiji (Crosse for *Schmeltziana*); Samoa Island (U.S. Nat. Mus.); Sunday Island, Kermadec group (T. Iredale for *corrugata*).

After carefully studying the shells described under the above four names I am of opinion that they belong to a single species. They are all more or less granular, with a dorsal groove, which, however, is absent in some smooth or only partly granose varieties. All are red-tipped anteriorly, and the character of the labral and columellar dentation is quite the same, although the actual number of teeth may vary somewhat according to the length of the labrum, the larger specimens having more than the smaller ones. Some examples from Mauritius are peculiar in the absence of a dorsal sulcus, and in being much smoother than typical specimens. There are, however, scattered minute granules upon the body-whorl, and the spire is distinctly granose. They offer no difference in form or colour. Some of the specimens from Port Shepstone belong to this smooth variety, but others are normally granular. The *E. sulcifera* of Sowerby's Thesaurus is a combination of *E. lachryma*, var. *callosa*, and the var. *Panamensis* of *E. laevis*. Figs. 1, 2 represent worn and dead specimens of *E. lachryma*, var. *callosa*, and fig. 3 is, as stated by Sowerby, the var. *Panamensis* (of *laevis*). The dorsal groove indicated in the figures is quite imaginary, as in the specimens in the Cuming Collection there is no indication of it, nor is it shown in Reeve's figure (Conch. Icon., fig. 14*b*), where one of the two Cumingian shells labelled *sulfifera* is depicted. Weinkauff (p. 153, pl. xxvi, figs. 11, 12) has merely copied Reeve's figures, and based his description upon them.

15. ERATO GALLINACEA, Hinds.

Ovulum gallinaceum, Hinds, Zool. Sulphur, 1844, p. 47, pl. xvi, figs. 1, 2.

Erato gallinacea, Sowerby (*b*), p. 83, figs. 33, 34; Reeve (*b*), figs. 7*a-b*; Weinkauff, p. 150, pl. xxv, figs. 14, 15; Tryon, p. 10, pl. iv, fig. 46 (after Sowerby).

E. angulifera, Sowerby (*b*), 1859, p. 83, figs. 25, 26; Reeve (*b*), figs. 6*a-b*; Weinkauff, p. 146, pl. xxv, figs. 1, 4; Tryon, p. 10, fig. 47 (after Sowerby).

Hab.—New Guinea and Straits of Macassar (Hinds); Mindoro, Philippines (Cuming); Torres Straits (Tryon); Borneo for *angulifera* (Sowerby); Paternoster and Kei Islands, Bima (Schepman).

This specimen is well characterized by its triangular pyriform shape, the very narrow linear aperture, the broad thickened labrum with the liræ extending almost across it, and similar liræ across the end of the body-whorl. A feature overlooked in all descriptions is the presence of a brown spot at the posterior end of the labrum and at the anterior extremity of the body-whorl. These spots are present in nearly all fresh specimens, but may not be noticeable in dead and worn shells. *E. angulifera*, founded on a few small worn specimens, possesses all the essential features of *gallinacea*.

No mention is made in the monographs by Reeve, Weinkauff, or Tryon of the "spira minutissime granulata" of Hinds, which is copied by Sowerby.

16. *ERATO* ANGISTOMA, Sowerby.

Erato angistoma, Sowerby (*a*), p. 18, fig. 51; Reeve (*b*), fig. 13; Tryon, p. 10, fig. 44 (copy of Sowerby).

E. angystoma, Sowerby (*b*), p. 83, figs. 19, 20, 23, 24.

E. pellucida, Reeve (*b*), fig. 16.

Hab.—Luzon, Philippines (Sowerby); East Indies (Sowerby and Reeve); Singapore (S. Archer); Port Jackson (Angas); Bombay (Reeve and Brit. Mus. for *pellucida*); Mast Head Reef, Capricorn Group, Queensland (Hedley).

I have not quoted Weinkauff in the above synonymy, as I do not feel sure that the shell figured by him (pl. xxvi, figs. 3, 4) belongs to this species. It is said to be 5 mm. in length, whereas the largest example I have seen is only 4 mm. *E. pellucida*, Reeve, is absolutely the same as the present species. The labral teeth are fine and numerous, about twenty-three in number.

17. *ERATO* OLIGOSTATA, Dall.

Erato oligostata, Dall, Nautilus, 1902, vol. xvi, p. 44; Bull. Mus. Comp. Zool. Harvard, vol. xliii, No. vi, p. 324, pl. xi, fig. 8.

Hab.—Bay of Panama.

A minute species with a hidden spire, "pale olive green, with the extremity of the canal deep rose pink."

The following species described or placed in *Erato* do not belong to this genus:—

a. *Erato guttula*, Sowerby (*a*), p. 18, fig. 50; Reeve (*a*), p. 261, pl. 285, figs. 8, 9.

Hab.—Mauritius.

The description of the "columellar lip with three folds anteriorly" and of the outer lip, "very minutely and indistinctly toothed along its inner margin," together with the figure, shows that this species is identical with *Marginella triplicata* of Gaskoin. The *E. guttata* [*sic*] of Sowerby (*b*) and Reeve (*b*) was founded on worn examples of the var. *callosa* of *E. lachryma*. Tryon, under *E. guttula*, reproduced Sowerby's figures of *guttata*, being under the impression that they represented the true *guttula*. Weinkauff noticed this species was a *Marginella*.

b. *Erato* (?) *cypræoides*, C. B. Adams, Proc. Boston Soc. Nat. Hist., 1845, vol. ii, p. 1.

Hab.—Jamaica.

Tryon (p. 10) considered this species "probably identical" with *E. Maugeræ*. A reference to the dimensions given by Adams shows, however, that it was a much larger shell he had before him, and I have no doubt that his species is the same as *Pachybatrion marginelloideum* of Gaskoin. Adams's specimens appear to have been worn and faded and to have lost the markings, excepting the brown stain below the suture described both by him and Gaskoin.

- c. *Erato hæmatina*, Menke, Sowerby (*b*), p. 82, figs. 17, 18; Reeve (*b*), figs. 8a-b.

Hab.—Porto Rico.

This species, as pointed out by Weinkauff (p. 17), is the same as *Marginella hematita*, Kiener.

- d. *Erato minuta*, Reeve (*b*), fig. 11.

Hab.—Island of Ticao, Philippines.

This is a very small *Marginella* belonging to the same group as *M. pisum*, Reeve and others. The description is practically useless, no mention being made of the columellar folds.

It is pyriformly ovate, pellucid, glossy; spire almost concealed by callus, not raised; labrum thickened and incurved, whiter than the rest of the shell, not denticulated at the edge; columella with three strong folds anteriorly, and four smaller tubercles above. The front fold of all joins the labrum, forming the anterior end of the very narrow aperture.

The lip is described by Reeve as "rather thin", but as this monograph was written not long before his death, such errors are perhaps pardonable, and allowance may be made for the very unsatisfactory character of the whole production.

- e. *Erato pellucida*, Tenison-Woods, Report Roy. Soc. Tasmania, 1878, p. 35.

Marginella pellucida: Tryon, p. 11.

= *M. Stanislas*, Ten.-Woods, 1876: Tate & May, Proc. Linn. Soc. N.S.W., 1901, vol. xxvi, p. 362, pl. xxvi, fig. 82.

Hab.—Tasmania.

Undoubtedly a *Marginella*, and, as pointed out by Tate & May, evidently the same as *M. Stanislas*, under which name Mr. Tenison-Woods had already described it two years previously.

- f. *Erato lactea*, Hutton, Man. N. Zeal. Moll., 1880, p. 63.

= *Marginella muscaria*, Lam.: Gillies, Trans. N. Zeal. Inst., 1881, vol. xiv, p. 170.

= *M. formicula*, Lam.: Tryon, p. 12.

Hab.—New Zealand.

As indicated by Mr. Justice Gillies, this species is evidently the *Marginella muscaria* of Lamarck. I do not agree with Tryon (p. 23) in considering *M. formicula* the same as *muscaria*.

NOTE ON THE VERY YOUNG STAGE OF THE GENUS
HUMPHREYIA.

By EDGAR A. SMITH, I.S.O.

Read 10th December, 1909.

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WHILST on a visit to England in the summer of 1907, Mr. C. Gabriel very kindly placed in my hands for examination a small Mollusc which he regarded as the very young form of *Humphreyia Strangei*. It was obtained by dredging in about 4 fathoms, on 4th December, 1905, off Phillip Island, Western Port Bay, Victoria, on a stony bottom, and associated with *Clavagella multangularis*, Tate.

I regret that beyond giving a description of its superficial characters I am at present not in a position to furnish any detailed information respecting its internal organization. Dr. Ridewood, who very kindly examined the unique specimen, found that the state of preservation was not sufficiently good to justify any expenditure of time in the way of a minute study. He suggested that the collector should be prevailed upon to endeavour to secure a complete series of specimens, from the youngest stage to the full-grown, when the working out of the anatomical details would be a matter of much interest. It is to be hoped, therefore, that Mr. Gabriel may have the opportunity some day of acting on Dr. Ridewood's suggestion, and that a good series of specimens may thus become available for investigation by the anatomist.

HUMPHREYIA STRANGEI, juv.

Shell very small, 5 mm. long, 4 high, consisting only of two flattish valves which are placed over the dorsal end of the ovate-globose body of the animal, covering only a limited portion of it, and

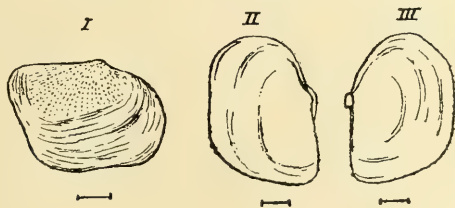
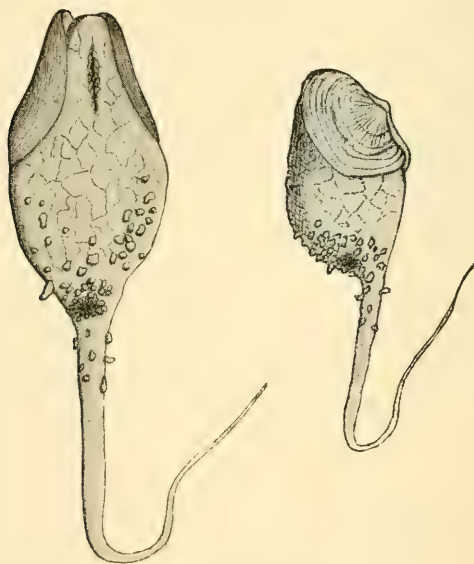


Fig. I, right valve, exterior; Fig. II, right valve, interior; Fig. III, left valve, interior, showing hinge-ligament.

diverging at the umbones at about a right angle. They appear to be closely attached to the surface, and exhibit, within, faint anterior to posterior adductor scars. Externally the valves are covered with

a thin, pale, olivaceous periostracum, which is more apparent towards the outer margin than at the umbones. The surface exhibits fine yet quite distinct lines of growth, radiating series of minute granulations towards the umbones, and faint traces of radiating sculpture upon the rest of the valves. In form they rather resemble *Mya truncata* in miniature, being somewhat quadrate, obliquely truncate behind, and more rounded in front. The beaks, although minute, terminate in a white rounded boss; they are contiguous, and inclined slightly anteriorly. The anterior dorsal margin is obliquely excurved, the posterior being parallel with the ventral, but slightly incurved. The hinge is edentate, and consists merely of a ligament attached just below the extreme margin of the valves posterior to the umbones. This ligament has a distinct shelly lining which is slightly convex on the underside, truncate, and broad at the hinder end, and narrowed in front. Interior of the valves white, almost silvery, concentrically wrinkled here and there.



The body of the animal is enclosed in a sack-like mantle, is soft, ovate-globose, terminating posteriorly in a thin whip-like process. The surface of the swollen part exhibits a sort of reticulation which may be merely the wrinkling of the delicate outer skin. Also numerous siliceous particles are adherent to the surface. This, however, is probably only an accidental feature. Two openings are observable, both apparently ventral, judging by the position of the shell. The anterior, situated between the ventral margins of the valve, is narrow and elongate. The posterior is at the other end of the body, near the commencement of the slender prolongation. It appears to be small

and transverse, and at this part the siliceous grains were very numerous.

The anterior slit may correspond to the pedal opening which is present in the animal of *Brechites*, and the posterior to the siphonal end of that genus. What may be the function of the flagelliform extension of the body I cannot offer an opinion upon. Can it possibly be an anchoring appendage? The adductor muscles are distinctly visible at the dorsal end of the body. On slitting the mantle the gills were seen to be very large, whereas both the foot and papi were minute. Length of swollen portion of the body about 10 mm., of the prolongation about 15 mm.

From the above description, brief as it is, it will be seen that the general features of this genus practically correspond to those of *Brechites* as described by Lacaze-Duthiers.¹

It is a matter of speculation at what period the animal commences to form the tube, but it seems probable that it would increase considerably before this takes place.

A fanciful account of the development of *Brechites* was given by Dr. J. E. Gray in the Ann. Mag. Nat. Hist., 1858, vol. i, pp. 423-6.

¹ Arch. Zool. Expér., sér. II, vol. i, pp. 665-732, pls. xxv-ix.

DESCRIPTION OF *THERSITES* (*GLYPTORHAGADA*) *HILLIERI*,
N.SP., FROM SOUTH CENTRAL AUSTRALIA.

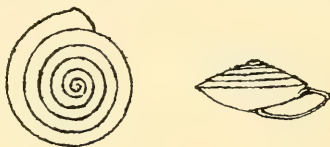
By E. A. SMITH.

Read 14th January, 1910.

AMONG a number of shells from the neighbourhood of Hermannsburg, South Central Australia, presented to the British Museum by H. J. Hillier, Esq., there were several specimens of a depressed carinated Helicoid form which appears to be undescribed. I have named the species after Mr. Hillier, who has presented to the National Collection various zoological specimens of considerable interest.

THERSITES (*GLYPTORHAGADA*) *HILLIERI*, n.sp.

Testa orbicularis, depressa, carinata, minute perforata, pallide fuscescens, vel albida; spira depressa conoidea, ad apicem obtusa; anfractus sex, lente accrescentes, ad suturam carinata, lineis incrementi tenuibus striati, superiores 2-3 leviter convexi, cæteri plani, declives, ultimus infra peripheriam acute carinatum convexiusculus,



antice haud descendens; apertura angulatim lunata; peristomium leviter incrassatum et reflexum, marginibus remotis, callo tenui junctis, basali ad insertionem paulo dilatato. Diam. maj. 18, min. 16.5 mm.; alt. 7 mm.

This is a depressed, acutely carinate species, like *T. Kooringsensis*, Angas, but with much narrower and more slowly increasing whorls, and not exhibiting the wrinkled sculpture of that species.

T. Howardi, Angas, from the same region, has fewer whorls and is widely umbilicated.

SOME REMARKS WITH REGARD TO PROFESSOR BOURNE'S
MONOGRAPH ON THE NERITIDÆ.

By Dr. H. SIMROTH.

Read 12th November, 1909.

WE owe many thanks to Professor Bourne for his most accurate study of the interesting family of the Neritidæ.¹ It is in no way my intention to criticize any of the many facts brought forward by him. But as I think I can give in several directions another interpretation, which may perhaps clear up the various difficulties he finds in the problem, I ask for permission to do so.

Professor Bourne unites all the forms of the great family in one genus, *Nerita*, which he divides into the four sections *Nerita*, s.s., *Paranerita*, *Septaria*, and *Neritina*. Here I may remark that Schepman² divides the group into two families, Neritacea and Neritilidæ, on conchological characters, the Neritilidæ comprising the genera *Neritilia* and *Septaria*. I should prefer the anatomical division of Bourne. As it is founded in the first place upon the genital organs I will begin with those.

Professor Bourne has had only female individuals of *Septaria*, but both sexes of all the other genera. I think I can explain the cause of the absence of males. When I once had a series of about thirty specimens of an undetermined species of *Septaria*, all the large individuals proved to be females, the males being small, only about half the diameter. Therefore it may be presumed that in this genus the males are dwarfed. Future investigation will have to decide whether the genus is hermaphroditic and proterandrous, developing first the male and afterwards the female organs, as is the case with many Pulmonata, or if the proterandric condition was a character of a hypothetical ancestor, the sexes being individually separated as at present.

I will now give the explanation of the compound structure of the genitalia. They differ widely from all Prosobranchs. But I do not find any difficulty in comparing them with those of the Pulmonata. Professor Bourne regards the ovary and the testis, the oviduct and the sperm-duct, as homologous organs. I shall endeavour to explain the homologies as completely as possible.

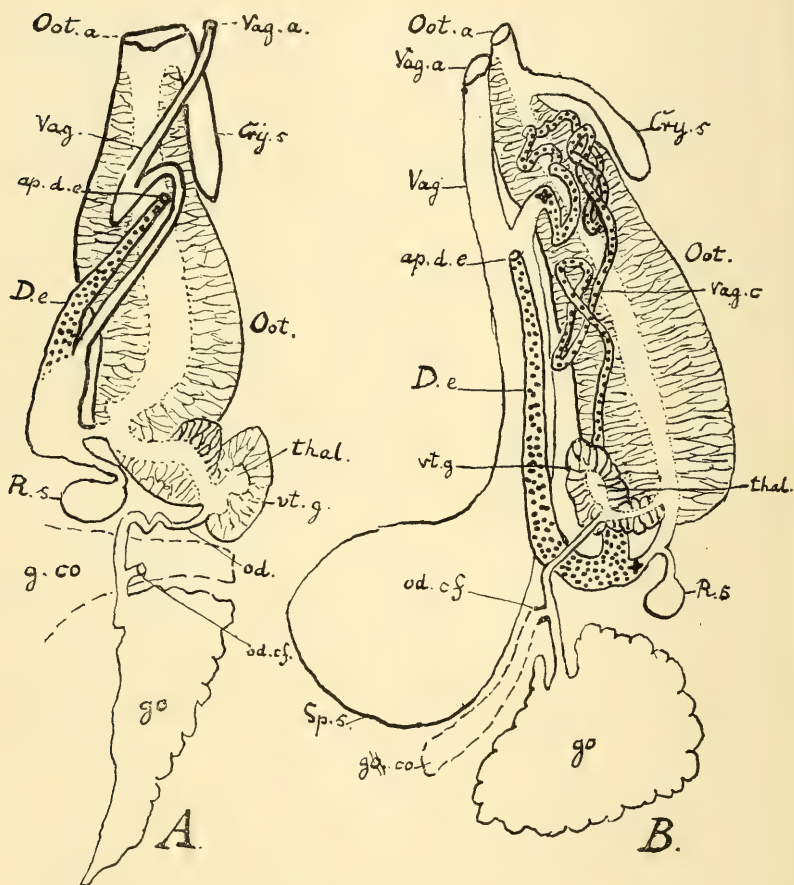
Female Organs.

Bourne uses the very good expression 'ootype' for uterus, thus indicating the descent from the Platodes. It is the female part of the Pulmonata—sperm-oviduct or uterus. The vitelline gland

¹ G. Bourne, "Contributions to the Morphology of the group Neritacea of Aspidobranch Gastropods." Part I: The Neritidæ. Proc. Zool. Soc. London, 1908, pp. 810-87, pls. xlyi-lxvi, and 1 text-fig.

² M. M. Schepman, "The Prosobranchia of the Siboga-Expedition." Part I: Rhipidoglossa and Docoglossa.

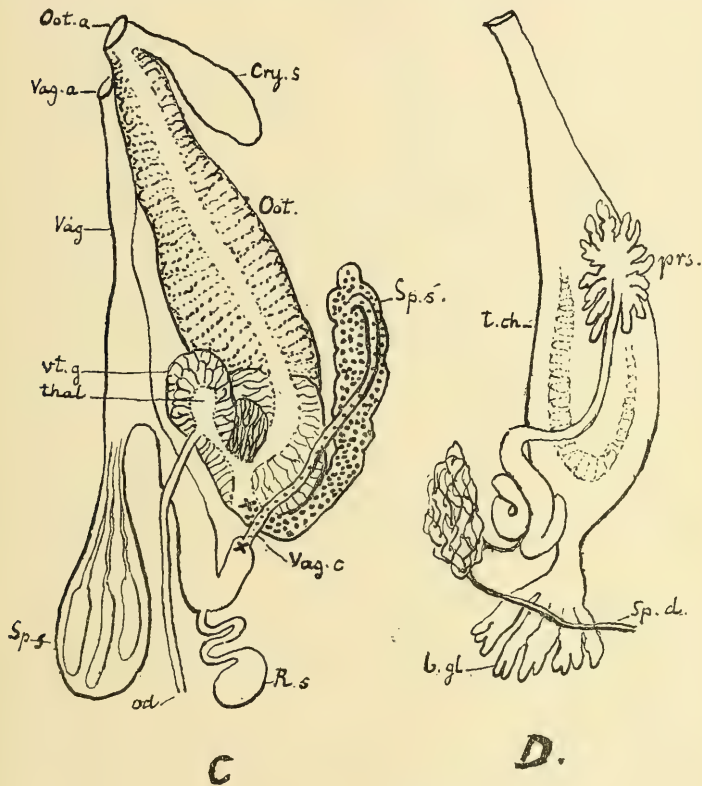
(*vt.g.*) is the albumen gland of authors. The other glands of the ootype are highly differentiated, more than in the Pulmonata. This is in connexion with the more complicated spawn. In the Stylommatophora there is only the egg-shell, in the Basommatophora the eggs are bound together by mucus, but in the Neritidæ the spawn is enclosed in a firm capsule, needing a new glandular differentiation for itself, as I have already pointed out in the Bronn Mollusca.



Bourne thinks that the crystal sac is a shell-gland, the chalk concretions of it being applied in forming the spawn capsule, but this is a hypothesis without observation, as he says himself. In my opinion the crystal sac is only a Pulmonate dart-sac, which ceased to act when the terrestrial ancestors were submerged under water.

A little chalk is still secreted in the common form of calco-sphærites, but no dart is formed.

The vagina is the same as in the Pulmonata. The receptaculum seminis is the bursa copulatrix, which is also named receptaculum by many authors. The sperm-sac or spermatophore-sac of *Paranerita* and *Nerita* (Figs. B and C, *Sp.s.*, but not Fig. C, *Sp.s'*.) is a secondary dilatation or a secondary bursa copulatrix. It is smaller in the true freshwater forms *Septaria* and *Neritina*, in *Neritina* being the smallest.



The cause of the dilatation and of its differences seems to be the following. In the terrestrial ancestor there was transferred in copulation *one* spermatophore, as in nearly all Pulmonata. The first tropical forms that invaded the sea, i.e. *Nerita*, and in a second degree *Paranerita* (for this see below), conserved the spermatophore, but transferred in one copula not one spermatophore but a number together (Fig. C). Whilst one spermatophore has room enough in the bursa or receptaculum (*R.s.*), the space is too narrow for the passing of several together; therefore the secondary bursa is formed

by dilatation (*Sp.s.*). *Septaria*, and especially *Neritina*, stayed in the fresh water, *Neritina* going farthest northward; in this way *Neritina* was adapted in the highest degree to the new conditions, it lost the spermatophore, transferring the sperm freely. Accordingly there no sperm-sac or secondary bursa is formed. The connecting canal between the receptaculum and thalamus is also to be found in the Opisthobranchia, e.g. *Aplysia* (= *Tethys*, Pilsbry). Many Pulmonata have the remains of it in the diverticulum. For this is sometimes, as shown by Semper, connected with the upper end of the sperm-oviduct at the point where the albumen gland is inserted.

There is still to be explained the enigmatic duct of *Septaria* (Fig. A), the enigmatic duct and vaginal canal of *Paranerita* (Fig. B), and the organs which Professor Bourne indicates in *Nerita* (Fig. C, *Vag.c.* and *Sp.s.*) all roughly dotted in my figures. The latter should not be so designated, the real sperm-sac being the bursa sperm-sac. All these things seem to be new formations, founded on mechanical causes. The bursting open and evacuation of the spermatophore is connected with a certain swelling or a kind of explosion, as I found once in *Arion*. The bursting of several spermatophores at the same time must augment the pressure, and the vaginal aperture being closed by muscular effort the pressure must take another way. It creates the enigmatic duct of *Septaria* (A), and the long vaginal canal and enigmatic duct of *Paranerita* (B). But in *Nerita* the dilatation and prolongation take place between the bursa or receptaculum and the thalamus. Therefore the vaginal canal and secondary sperm-sac of *Nerita* (Fig. C, *Vag.c.* and *Sp.s.*) are not strongly homologous to the dotted organs in Figs. A and B, but homodynamic, as founded on the same functional causes. In Figs. B and C I have indicated the points between which the prolongation has taken place by a cross (+). By joining the two points the normal disposition would be given.

Male Organs.

The great prolongation of the sperm-duct is not rare in Pulmonata, e.g. *Vaginula* and *Oncidium*, as well as the dilatation of the sperm-duct or hermaphrodite duct in the distal part. Yet the prostate has always another aspect, for its tubes are inserted along the long sperm-oviduct, sometimes at intervals, as in *Agriolimax* or *Vitrina*. But take off the oviducal part of it, or uterus, and the tubes will approach as in *Nerita* (Fig. D, *prs.*). Spermatophores being formed, the terminal chamber (*t.ch.*) is nothing else than the epiphallus, and the basal gland is a flagellum. Its splitting up into many branches is not unparalleled, e.g. in *Agriolimax*.

It is quite uncertain if the cephalic penis was originally joined with the genital aperture by an inner vas deferens or an outer sperm groove, for we have to go back to a very old and primitive stock.

Other Organs.

Back to such a stock points also the oviduco-cœlomic funnel, discovered by Bourne. Perhaps he is not right in concluding that the genital canal must have been the right nephridium, for the use

of the cœlomic or pericardial ducts as nephridia is already a secondary function. Nierstrasz¹ has lately shown that the Solenogastres possess these ducts, but without excretory functions.

In the same way the question arises whether there is only the left ctenidium or also the remains of a right one. In my opinion the ctenidia are secondary acquisitions on the margin of the mantle, as in *Valvata*, the typical hermaphrodite freshwater Prosobranch. In one species of *Pleurotomaria* Bouvier found in the hind part of the mantle-cavity a typical network of blood-vessels as in the Pulmonate lung, the ctenidia being restricted to the outer parts. *Valvata* shows that the right ctenidium is already vanishing before it enters into the mantle-cavity itself. Therefore I think it uncertain whether the right ctenidium in *Nerita* was once fully developed or not. Perhaps the rudimentary right ventricle of the heart is a proof of the full development in the ancestors. Professor Bourne has given a valuable description of the nervous system. He demonstrates that the pedal ganglia are rounded organs, and that there are no transverse commissures between the pedal nerves. The pleural ganglia are joined by a short commissure with a ganglion therein, as in many Pulmonata. And even the absence of the supra-intestinal nerve in *Neritina* connects their form more closely with the Pulmonata.

Other organs, e.g. the radula, can be taken in the same sense. The rhipidoglossate radula is a highly differentiated one, whereas many Pulmonata, e.g. *Ostracolethe*,² possess an equally large number of denticles, but all of the same simple form. The stomach has a diverticulum, homologous to the spiral cæcum of many Aspidobranchs. Its absence in *Neritina* is in accordance with its higher systematic position (see above). The same diverticulum we find in the Cephalopoda, but not less in the Aplysiidæ,³ where it is described as liver cæcum; and I may add that among the Pulmonata one species of *Hyalimax* possesses the same organ, whereas it is wanting in others, agreeing with what we find in the Neritidæ. The cæcum is the sign of great antiquity, which is lost in the progress of development. The nephridium of the Neritidæ, as described by Professor Bourne, is composed of an excretory part and of a non-excretory part. He avoids naming the latter part ureter, because it is not a straight duct. But have we not such ureter forms in many Pulmonata, e.g. *Limax* and *Arion*?

The Geographical Distribution.

Given the similarity of most of the organs of the Neritidæ to the Pulmonata, we may ask whether the Pulmonata are derived from the Neritidæ or the Neritidæ from the Pulmonata. Perhaps the

¹ H. F. Nierstrasz, "Die Amphineuren": Ergebnisse und Fortschritte der Zoologie, herausgeg. von Spengel, Bd. i, Heft ii.

² Simroth, Zool. Anz., vol. xxv, p. 62.

³ F. M. MacFarland, "The Opisthobranchiate Mollusca of the Branner-Agassiz Expedition to Brazil"; Leland Stanford, jun., Univ. Publications, Univ. Series II, 1909.

majority of zoologists would be inclined to derive the Pulmonata from the Neritidæ in accordance with the common view that the marine forms were the precursors of the terrestrial. My opinion is the reverse with regard to most cases, and chiefly to the present one. The formation of spermatophores is only the exception among the Prosobranchia, it is the rule among the Pulmonata. Therefore¹ the probability is that the Pulmonata are the older stock. The same is proved by the single spermatophore and the typical bursa copulatrix in the Pulmonata, whereas the several spermatophores and the secondary bursa testify the derived character of the Neritidæ.

All this is in accordance with the geographical distribution in connexion with the pendulation theory.² Professor Bourne regards the tropical marine *Neritæ* as the oldest stock. But he cannot find its ancestors. He considers the Helicinidæ, the nearest allies of the Neritidæ, as a young group, because they are not found in a fossil state. Therefore he thinks that the similarity of the Palæozoic *Dawsonella* with the Helicinidæ is founded only upon convergence, and not upon true affinity. Why not? I do not think the palæontological argument can demonstrate the contrary. If I am right, between the Palæozoic Pupæ and the modern living forms we have the same gap. And this is not surprising, as terrestrial animals have not so good a prospect of being preserved in a fossil state as aquatic ones. The geographical distribution of the Helicinidæ is a most striking argument for their age. They inhabit two separated areas, in the east and in the west. *Dawsonella* demonstrates that they once lived in our European-North American quadrant, when we were in a more southern position. By the pendulating movement directed northward, they were obliged to retire into the areas of the east and west poles with a constant tropical climate, where we find them to-day. The old Neritidæ were also originally tropical terrestrial forms, but during the same pendulating movement they retired into the sea with its more equal temperature, and acquired one or two gills, or they retired into fresh water, the freshwater forms being those which were more able to adapt themselves to diminishing temperature during the northward movement under the swinging circle, as the conditions of fresh water conform more to those of the soil. The old freshwater stock was changed to *Paranerita*, and in the torrents to *Septaria*. When the pendulating movement transferred their area further northward, they retired into the warmer parts of the globe. One part became submerged under sea-level, another stayed in fresh water, *Septaria* retiring into the east pole area occupying the former under-ridges from Ceylon to Mauritius, and through the Pacific to the coral islands. The allied *Pileolus* of the Secondary age seems to prove that even this stock originated in Europe. Finally, that part which persisted for the longest time in fresh water, and became adapted to the lowest temperature, losing in the meantime the faculty of

¹ H. Simroth, "Die Entstehung der Landtiere"; Leipzig, 1891.

² H. Simroth, "Die Pendulationstheorie"; Leipzig, 1907.

forming spermatophores,¹ is *Neritina*, but even the most northern living species, *N. fluviatilis*, is at the present time invading the sea in the Baltic on its northern confines under the swinging circle.

¹ I consider the transferring of the sperm by one spermatophore of the Pulmonata as the primary state, and the several spermatophores of *Nerita* as the secondary. Here it could be objected that the Cephalopoda in copulation behave in the same manner as *Nerita*. But I should remark that I have tried to derive also the Cephalopoda from an old terrestrial Pulmonate stock. The palæontological appearance of the different Cephalopoda groups is in full agreement with the pendulation theory.

NOTE ON *SCULPTARIA*, PFEIFFER.

By JOHN H. PONSONBY, F.Z.S.

Read 12th November, 1909.

THE name *Sculptaria* first appears, without definition, in Malak. Blätt., 1855, p. 135, in Pfeiffer's synopsis of the Helicidæ, the type and then only species being *sculpturata*, Gray. In 1859 (Mon. Hel., vol. iv, p. 2) he quotes *Sculptaria* amongst other "novæ sectiones in genere Helice", and again, p. 299, in his reference to *H. sculpturata*. The name reappears in Pætel's Catalogue of Family and Generic Names, 1875, p. 187, as a "section of *Helix*", and in Clessin's Nomenclator, 1881, p. 105, as a subsection of *Gonostoma*. In the Catalogue of the Pætel Collection, 1883, p. 121, and in that of 1889, p. 82, it occurs as a "section of *Gonostoma*". Tryon, in *Structural and Systematic Conchology*, 1884, vol. iii, p. 33, quotes it as "uncharacterised", while in his Manual, vol. iii, p. 138, it figures as a subsection of the group Anchistoma. Von Martens, in Nachr. Blätt. deutsch. Malak. Ges., calls *Sculptaria* a "small natural group" of *Helix* (1889). Pilsbry, having referred to it in the Manual, vol. viii, p. 152, as "a group of unknown affinities", proceeds in vol. ix, p. 39 (1894), to define the ? subgenus with his usual care and accuracy. Guided perhaps by geographical considerations, he places it next to *Phasis*, Alb., and in the same volume, p. 340, he recognizes it as a genus, remarking that it may belong to the Protogona. The anatomy being still unknown in 1895, he was obliged to leave it in the "Synopsis of Families", etc., published at the end of the Index to the Helices, p. 123, with a '?' in the same position, and here it must remain till an examination of the soft part determines the generic position. The same view was taken by Sturany, who, in his Südafrik. Moll., 1898, p. 48 of reprint, classes *Sculptaria* as a subgenus of *Phasis*. There are at present four species known, all from the south-west of Africa (Damaraland and thereabouts): the following notes may, it is hoped, help to clear up the somewhat confusing synonymy. A word of thanks to Mr. Edgar Smith, I.S.O., whose ever ready assistance and valuable advice are gratefully acknowledged.

SCULPTARIA SCULPTURATA (Gray).

1838. *Alexander's Expedition into the Interior of Africa*, vol. ii, p. 268 (*Helicodonta*).
 1845. Pfeiffer, Zeitsch. f. Malak., p. 86.
 1848-76. Pfeiffer, Mon. Hel., vol. i, p. 408; vol. iv, p. 299; vol. v, p. 400; vol. vii, p. 453.
 1854. Reeve, Conch. Icon., fig. 1471.
 1868. Morelet, Voyage Welwitsch, Mollusques, p. 43.
 1881. Clessin, Nomencl., p. 105 (*Sculptaria*).
 1885. Kobelt, Conch. Cab., p. 621, pl. clxxviii, figs. 26-8 (with syn. *collaris*, Pfr.).

1887. Tryon, Manual, vol. iii, p. 138, pl. xxv, fig. 69 (with var. *collaris*, Pfr., and *Damarensis*, H. Ad.).
 1889. Pætel, Cat., vol. ii, p. 181 (with var. *collaris*, Pfr., and *Damarensis*, H. Ad.).
 1889. Von Martens, Nachr. Blätt. deutsch. Malak. Ges., p. 154 (*Sculptaria*).
 1894. Pilsbry, Manual, vol. ix, p. 39, pl. x, fig. 4 (with var. *collaris*).
 1896. Id., Nautilus, vol. ix, p. 108.
 1897. Von Martens, Archiv f. Naturges., Bd. i, p. 39.
 1898. Sturany, Südafrik. Moll., p. 49 (reprint), with var. *collaris*, Pfr.

Gray's original description: "*Helicodonta sculpturata*, Gray. Shell depressed, umbilicated, white; whorles with an irregular subcentral keel, and several spiral ridges, crossed with close narrow concentric ridges; mouth rhombic ovate with a reflexed lip; throat with a strong ridge in the centre of the inner, and two equidistant ones on the outer lip. Diameter $3\frac{1}{2}$ lines." Type in Nat. Hist. Museum. It is a flat, somewhat coarsely reticulated species, the "spiral ridges" being very prominent. Diam. maj. 8, min. 7 mm.; alt. 2.5 mm.

Hab.—Damaraland.

SCULPTARIA COLLARIS (Pfr.).

1867. Pfeiffer, Malak. Blätt., vol. xiv, p. 197 (*Helix*).
 1867–9. Id., Novit. Conch., vol. iii, p. 496, pl. cvii, figs. 5–9.
 1868. Id., Mon. Hel., vol. v, p. 506.
 1876. Id., op. cit., vol. vii, p. 465 (with syn. *Damarensis*, H. Ad.).
 1881. Clessin, Nomencl., p. 105 (with syn. *Damarensis*, H. Ad.).
 1885. Kobelt, Conch. Cab., p. 621 (as syn. of *sculpturata*, Gray), ? pl. clxxxviii, figs. 26–8.
 1887. Tryon, Manual, vol. iii, p. 138 (as *sculpturata*, Gray, var.), pl. xxiv, figs. 27, 28.
 1889. Pætel, Cat., vol. ii, p. 118 (as syn. of *sculpturata*, Gray).
 1889. Von Martens, Nachr. Blätt. deutsch. Malak. Ges., p. 154 (with syn. *Damarensis*, H. Ad.).
 1894. Pilsbry, Manual, vol. ix, p. 39 (as *sculpturata*, Gray, var.).
 1897. Von Martens, Archiv f. Naturges., Bd. i, p. 39 (with var. *Damarensis*, H. Ad.).
 1898. Sturany, Südafrik. Moll., p. 49 (reprint), with syn. *Damarensis*, H. Ad.

Smaller and more delicately sculptured than the preceding: the radiating costæ, which cross the fine concentric striæ, gradually fade away, and do not reach the suture below. As Pfeiffer very justly observes, "species persingularis—*H. sculpturata* modo characteribus nonnullis peraffinis," but quite distinct in others. Diam. maj. 6.33, min. 5.25 mm.; alt. 2 mm.

Hab.—(At first, apparently unknown) Damaraland.

SCULPTARIA DAMARENSIS (H. Adams).

1870. P.Z.S., p. 379 (*Corilla*), pl. xxvii, fig. 14.
 1876. Pfeiffer, Mon. Hel., vol. vii, p. 465 (as syn. of *collaris*, Pfr.).
 1879. Kobelt, Ill. Conchyl. Buch., vol. ii, pl. lxx, fig. 23.

1881. Clessin, Nomencl., p. 105 (as syn. of *collaris*, Pfr.).
 1887. Tryon, Manual, vol. iii, p. 138 (as *sculpturata*, Gray, var.), pl. xxv, figs. 67, 68.
 1889. Von Martens, Nachr. Blätt. deutsch. Malak. Ges., p. 154 (as syn. of *collaris*, Pfr.).
 1889. Pætel, Cat., vol. ii, p. 123, as syn. of *sculpturata*, Gray (*Damarensis*, A. Adams).
 1890. Ancey, Bull. Soc. Malac. France, vol. vii, p. 156 (*Sculptaria Chapmanni*).
 1892. Id., Brit. Natur., p. 126, *S. Chapmani* [sic] changed to *Melvilliana*, Ancey.
 1892. Pilsbry, Manual, vol. viii, p. 152 (*S. Chapmanni*, Anc.).
 1894. Id., op. cit., vol. ix, pp. 39, 340 (*S. Damarensis*, H. Ad., and *Chapmani*, Anc.).
 1897. Von Martens, Archiv f. Naturges., Bd. i, p. 39 (as *collaris*, Pfr., var.).
 1898. Sturany, Südafrik. Moll., p. 48 (reprint), *S. Chapmanni*, Anc., and *Damarensis*, H. Ad.

Diam. maj. 9, min. 7 mm.; alt. 4 mm.

Hab.—Damaraland (Walfisch Bay).

Some years ago the late M. Ancey sent over to this country the type-specimen of his *S. Chapmanni*, or *Melvilliana*: it proved to be absolutely identical with *S. Damarensis*—a fact recorded at the time on the back of the tablet to which the type of Adams's species is affixed at the Nat. Hist. Museum. This is the largest species of the genus: the spire is more raised, and the sculpture is weaker than in any of its allies.

SCULPTARIA RETISCUPTA (von Martens).

1889. Nachr. Blätt. deutsch. Malak. Ges., p. 154, *Helix* (*Sculptaria*).
 1892. Pilsbry, Manual, vol. viii, p. 152, and 1894, vol. ix, p. 39.
 1894. Martens, Conch. Mitth., Bd. iii, Heft iii, p. 5.
 1897. Id., Archiv f. Naturges., Bd. i, p. 38, pl. vii, figs. 5-7.
 1898. Sturany, Südafrik. Moll., p. 48 (reprint).
 1899. Gude, Journal of Malacology, vol. vii, pt. iv, p. 90.

Diam. maj. 6, min. 5 mm.; alt. 3 mm.; apert. diam. 2 mm.

Hab.—Ussab, in Damaraland.

Von Martens, in his original description, gives careful notes on the specific characters of this exceedingly beautiful little shell, which indeed cannot be confounded with any of its congeners.

NOTES ON THE GENUS *LIBERA*.

By J. H. PONSONBY, F.Z.S.

Read 10th December, 1909.

THE genus *Libera* was defined by Garrett in Journ. Acad. Nat. Sci. Phil., 1881, ser. II, vol. viii, p. 390, no mention being made of any type, though it may be, perhaps, inferred from a remark on p. 389 that he considered *Helix bursatella*, Gld., 1846, to be the type. It was not till 1894 that Pilsbry, in the Man. Conch., vol. ix, p. 23, selected *subcavernula*, Tryon, to represent the genus. It is, perhaps, a pity that he did not choose the older species, *bursatella*, which is in every way typical, besides being distinctly in literature the ancestor of the group. Gould evidently considered, as shown by his description and figures, that he was dealing with one very variable form, but several species were subsequently carved out of it. This led to much confusion, for, as Garrett rather quaintly observes, "Dr. Pfeiffer appears to have been somewhat bewildered in his treatment of the various species described by Gould, Reeve, Hombron and Jacquinot, and himself." In 1849 Pfeiffer described *Jacquinoti* and *coarctata*, species which he then proceeded to mix up in the most unaccountable and perplexing way with others described by Hombron & Jacquinot. Garrett subsequently described several species, and his excellent papers are full of information about the shells and their inhabitants, and their curious habit of "ovopositing into their cavernous umbilicus" (see also Cooke in Cambridge Nat. Hist., vol. iii, Mollusca, pp. 128, 327, 441). The group, comprising ten species, seems to be confined to the Society and Cook Islands, though *fratercula* has been quoted from Gambier Island and Paumotu, and the Marquesas have been given as the habitat of *Jacquinoti*, which, however, Garrett is "inclined to believe" inhabits the Austral Islands.

Mention must here be made of *Helix oceanica*, Le Guill., a species included by some writers in this genus. Described in 1842 (Rev. Zool., p. 140), it has never been figured. Pfeiffer copied the description in Mon. Hel., vol. i, p. 120, but adds nothing in the subsequent volumes. Gould, in the "Otia", quotes it as synonym of the all-embracing *H. bursatella* (in which case Le Guillou's name would have priority!) from a specimen in the Jardin des Plantes. Pease quotes it in P.Z.S., 1871, remarking that no mention is made of any peristomatal lamellæ. In Pætel it appears as a *Goniodiscus*. Fischer and others make it a *Patula*, and so on. Through the kindness of Dr. L. Germain the writer was able to inspect a specimen so named in the Paris Museum; it proved to be *Jacquinoti*, Pfr. Mons. Dautzenberg obligingly submitted a specimen from the collection of Mons. Crosse; it turned out to be *bursatella*, Gld. As the description is meagre, as there is no figure, and as there is apparently no authentic specimen, it is suggested that *Helix oceanica*, Le Guill., may safely be relegated to the limbo of 'species incognitæ'.

It may be of some interest to remark that on reference to the *Voyage au Pole Sud*, the authorship of which is ascribed to Hombron and Jacquinot, it will be seen that the descriptions of the shells were written, not by those gentlemen, but, as appears on the first page, by "L. Rousseau, Aide Naturaliste au Muséum d'histoire naturelle". In the 'introduction', signed by the above-named Rousseau, he states that "as Messrs. Hombron & Jacquinot have had most of the shells figured and determined, it only remained for me to describe them". This he proceeds to do, attributing the authorship to Hombron and Jacquinot. It is left to those who are skilled in bibliography to determine who, under the circumstances, should be considered to be the authors.

The species may be arranged as follows:—

1. *subcavernula*, Tryon (*cavernula*, Garr., non H. & J.).
2. *fratercula*, Pse. (*sculptilis*, Pse., non Bland).
3. *Jacquinoti*, Pfr. (*bursatella*, Gld., part.; *cavernula*, H. & J., non Garr.).
4. *bursatella*, Gld.
5. *tumuloides*, Garr.
6. *retunsa*, Pse.
7. *streptaxon*, Rve. (*bursatella*, Gld., part.; *turricula*, H. & J., non Lowe; *coarctata*, Pfr., non Desh.).
8. *gregaria*, Garr.
9. *recedens*, Garr.
10. *Heynemanni*, Pfr. (*bursatella*, Gld., part. (Garrett); ? *excavata*, H. & J., non Bean).

1. LIBERA SUBCAVERNULA, Tryon.

1872. Garrett, Amer. Journ. Conch., vol. vii, p. 226, pl. xix, fig. 16 (*cavernula*, Garr., non H. & J., 1854).
1874. Cat. Mus. Godeff., v, p. 94 (*Patula*).
1876. Pfr., Mon. Hel., vol. vii, p. 538 (quotes Amer. Journ., vol. vii, p. 229 *vice* 226).
1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220 (*Patula*).
1881. Clessin, Nomenclator, p. 96.
1881. Garrett, Journ. Acad. Nat. Sci. Phil., p. 392.
1887. Tryon, Manual, vol. iii, p. 70 (*subcavernula*, Tryon), pl. xiii, figs. 67–9.
1889. Pætel, Cat., p. 91.
1894. Pilsbry, Manual, vol. ix, p. 24 (*subcavernula*, Tryon): selected as type of genus, p. 23, pl. v, figs. 45–7.
- Hab.*—"Peculiar to Rarotonga" (Garrett).

2. LIBERA FRATERCULA, Pease.

1864. Pse., P.Z.S., p. 669, *sculptilis*, Pse. (non Bland, 1858).
1867. Pse., Amer. Journ. Conch., vol. iii, p. 104 (*fratercula*, Pse.).
1868. Pfr., Mon. Hel., vol. v, p. 217 (*sculptilis*).
1871. Pse., P.Z.S., pp. 452, 475 (*Pity's fratercula*), Rarotonga.
1872. Garrett, Amer. Journ. Conch., vol. vii, p. 226.
1874. Cat. Mus. Godeff., p. 94 (*Patula sculptilis*).

1876. Pfr., Mon. Hel., vol. vii, p. 253.
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 221 (*Patula fratercula*, Gambier), Cook Island (p. 222).
 1881. Clessin, Nomencl., p. 95, *End. fratercula*, Pse. (*sculptilis*, Pse.).
 1881. Fischer, Manuel, p. 255 (*Patula*).
 1881. Garrett, Journ. Acad. Nat. Sci. Phil., p. 392 (*Libera*).
 1887. Tryon, Manual, vol. iii, p. 70, pl. xiii, figs. 64-6.
 1889. Pætel, Cat., and var. *sculptilis*, p. 85.
 1894. Pilsbry, Manual, vol. ix, p. 24, *sculptilis*; altered p. 339 to *fratercula*, pl. v, fig. 48, *fratercula* (young), p. 23 (in explan. of plates, p. 347, as *subcavernula*).

Hab.—Mangier Island (? Mangaia Island, Garr.), Harvey Island (Pse.), Paumotus, Gambier Island (Fischer), Gambier and Cook Islands (Kobelt).

3. *LIBERA JACQUINOTI*, Pfr.

1849. Pfr., Zeits. für Malak., p. 73 = *bursatella*, Gld., var. β .
 1849. Pfr., P.Z.S., p. 128.
 1852. Reeve, Conch. Icon., vol. vii, fig. 631 (*ex* Mus. Cum.).
 1853. Conch. Cab., p. 296, pl. cxxv, figs. 26-8 (*bursatella*, Gld., β ; *excavata*, H. & J.).
 1853. Pfr., Mon. Hel., vol. iii, p. 143 (syn. *excavata*, H. & J.; *bursatella*, Gld., β ; Homb. & Jacq., Voyage au Pole Sud, p. 21 (*cavernula*, H. & J.), figs. 3-6).
 1857. Pfr., Malak. Blätt., p. 33 (*bursatella*, Gld., var., figs. 52*d*, *f*; *cavernula*, Jacq.).
 1858. H. & A. Adams, Genera, vol. ii, p. 113 (*Pityls Jacquinoti*).
 1859. Pfr., Mon. Hel., vol. iv, p. 154 (? *cavernula*, H. & J.).
 1860. Albers, Heliceen, p. 90 (*Endodonta Jacquinoti*).
 1868. Pfr., Mon. Hel., vol. v, p. 220 (? *cavernula*, Jacq.).
 1871. Pse., P.Z.S., pp. 452, 475 (= *cavernula*, H. & J.).
 1872. Garrett, Amer. Journ. Conch., vol. vii, p. 226.
 1876. Pfr., Mon. Hel., vol. vii, p. 255 (syn. *excavata*, H. & J., p. 568 = *cavernula*, Jacq. *ex* Pease).
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220 (*Patula Jacquinoti*, Pfr.).
 1881. Fischer, Manuel, p. 255 (*Patula Jacquinoti*).
 1881. Clessin, Nomencl., p. 96 (syn. *excavata*, H. & J.).
 1884. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 34.
 1887. Tryon, Manual, vol. iii, p. 71, syn. *excavata* and ? *bursatella*, var., pl. xiii, figs. 75-7 (copies of H. & J., fig. of *excavata*).
 1889. Pætel, Cat., p. 86 (syn. *cavernula*, H. & J., p. 83).
 1894. Pilsbry, Manual, vol. ix, p. 24 (with syn. *excavata*, H. & J.).

Hab.—Tahiti and Marquesas (? Austral Islands, Garrett).

I have tried unsuccessfully to borrow Pfeiffer's type-specimen, said to be in the Museum at Stettin. The figure in Conch. Cab. is not satisfactory, nor indeed is Reeve's.

4. *LIBERA BURSATELLA*, Gld.

1846. Proc. Bost. Soc. Nat. Hist., vol. ii, p. 175.
 1847. Pfr., Mon. Hel., vol. i, p. 185, cum varr. *a* and β .

1849. Pfr., Zeitsch. für Malak., p. 72.
 1850. Albers, Heliceen, p. 89 (*Endodonta*).
 1851-6. Woodward, Manual, p. 424, "Taheiti at 2-5000 alt." (*Helix*).
 1852. Gould, Expedition Shells, p. 51.
 1852. Reeve, Conch. Icon., vol. vii, fig. 635 (*Helix*).
 1852-3. Pfr., Conch. Cab., p. 296 (syn. *turricula*, H. & J.), pl. cxxv, figs. 23-5.
 1853. Pfr., Mon. Hel., vol. iii, p. 142 (syn. *turricula*, H. & J.).
 1856. Gould, Expedition Shells, pl. iv, figs. 52, 52a-2m (52b *ex err.* numbered 54b).
 1857. Pfr., Malak. Blätt., p. 33 (?=*excavata*, Jacq.).
 1858. H. & A. Adams, Genera, vol. ii, p. 113 (*Pitys*).
 1859. Pfr., Mon. Hel., vol. iv, p. 154 (syn. *excavata*, Jacq.).
 1860. Albers, Heliceen, p. 90 (*Endodonta*).
 1862. Gould, Otia, p. 22, p. 243 (*Pitys*), with synonymy, = *coarctata*, Pfr., 1849, + *turricula*, H. & J. (a distorted var.), + *excavata*, H. & J. (immature), and *streptaxon*, Rve., 1852, = *cavernula*, Jacq., = *oceanica*, Le Guill., "in Jardin des Plantes"!
 1868. Pfr., Mon. Hel., vol. v, p. 219 (syn. *excavata*, H. & J.).
 1869. Frauenfeld, Verh. Zool.-bot. Ges., Wien (*Pitys*), p. 873.
 1870. Semper, Reisen Arch. Philipp., Theil ii, Band iii, p. 135, pl. xvi, fig. 18 (genitalia).
 1871. Pse., P.Z.S., pp. 452, 475 (synonymy).
 1872. Garrett, Amer. Journ. Conch., vol. vii, p. 226.
 1875. Binney, Proc. Acad. Nat. Sci. Phil., p. 248, pl. xxi, fig. 6 (dentition).
 1876. Pfr., Mon. Hel., vol. vii, pp. 255, 567 (syn. *excavata*, H. & J., "teste Pease").
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220 (*Patula*).
 1881. Clessin, Nomencl., p. 96 (*Endodonta*).
 1881. Fischer, Manual, p. 255 (*Patula*).
 1881. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. viii, p. 390 (*Libera*).
 1884. Id., op. cit., vol. ix, p. 33.
 1887. Tryon, Manual, vol. iii, p. 71 (not *turricula*, H. & J.), pl. xiii, fig. 86.
 1889. Pætel, Cat., p. 82 (*Endodonta*), p. 112 (syn. *Jacquinoti*).
 1894. Pilsbry, Manual, vol. ix, pp. 23, 24.

Hab.—Tahiti and Eimeo.

5. LIBERA TUMULOIDES, Garrett.

1872. Garrett, Amer. Journ. Conch., vol. vii, p. 225, pl. xix, fig. 15.
 1874. Cat. Mus. Godeff., vol. v, p. 94.
 1875. Binney, Proc. Acad. Nat. Sci. Phil., p. 248, pl. xxi, fig. 6 (dentition).
 1876. Pfr., Mon. Hel., vol. vii, p. 567.
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 222.
 1881. Fischer, Manuel, p. 255 (*Patula*), Cook and Harvey Islands.
 1881. Clessin, Nomencl., p. 96.
 1881. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. viii, p. 393.

1887. Tryon, Manual, vol. iii, p. 70, pl. xiii, figs. 70-1.
 1889. Pætel, Cat., p. 91 (*Pityts*).
 1894. Pilsbry, Manual, vol. ix, pp. 23, 24, pl. ix, fig. 26 (dentition).
Hab.—Rarotonga (Cook Island).

6. *LIBERA RETUNSA*, Pse.

1864. P.Z.S., p. 670.
 1868. Pfr., Mon. Hel., vol. v, p. 220.
 1871. Pse., P.Z.S., p. 475 (*Pityts*).
 1872. Garrett, Amer. Journ. Conch., vol. vii, p. 226.
 1876. Pfr., Mon. Hel., vol. vii, p. 256.
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220, *Patula retusa* [sic], Pse.
 1881. Clessin, Nomencl., p. 95 (*Endodonta*).
 1884. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 35, pl. ii, fig. 8.
 1887. Tryon, Manual, vol. iii, p. 71, pl. xiii, fig. 81.
 1889. Pætel, Cat., p. 89 (*Pityts*).
 1894. Pilsbry, Manual, vol. ix, p. 24.
Hab.—Tahiti.

7. *LIBERA STREPTAXON*, Rve.

1849. Pfr., Zeitsch. für Malak., p. 74, *coarctata*, Pfr., non Fér. (Desh.).
 1849. Pfr., P.Z.S., p. 128.
 1850. Albers, Heliceen, p. 89 (*Endodonta coarctata*, “Pfr. M.S.”).
 1852. Reeve, Conch. Icon., vol. vii, pl. cxii, fig. 641, *streptaxon* (syn. *coarctata*, Pfr.); Conch. Cab., p. 297, pl. cxxv, figs. 29-31, *cavernula*, H. & J. (syn. *coarctata*, Pfr., and *streptaxon*, Rve.).
 1853. Pfr., Mon. Hel., vol. iii, p. 143, *cavernula*, H. & J. (syn. *coarctata*, Pfr.).
 1854. H. & J., Voyage au Pole Sud, p. 19, pl. vi, figs. 21-4 (*turricula*, H. & J., non Lowe, 1833).
 1857. Pfr., Malak. Blätt., p. 34 (*streptaxon*, Pfr., Rve., = *coarctata*, Pfr. olim, nec Desh., = *bursatella*, Gld., figs. 52b-c, = *turricula*, Jacq., nec Lowe, = *cavernula*, Pfr., nec Jacq.).
 1858. Adams, Genera, p. 113, *Pityts cavernula*, H. & J. (fide Pfr.).
 1859. Pfr., Mon. Hel., vol. iv, p. 154 (*streptaxon*, Rve.; syn. *coarctata*, Pfr.; *turricula*, H. & J.; *cavernula*, Pfr., vol. iii, p. 143; *cavernula*, H. & A. Adams). He also quotes the figure in Conch. Cab. above mentioned, and figs. 52b-c of pl. iv of Gould's Expedition Shells, and above-mentioned fig. in Conch. Icon.
 1860. Albers, Heliceen, p. 90, *Endodonta cavernula* (fide Pfr.).
 1868. Pfr., Mon. Hel., vol. v, p. 220 (syn. *cavernula*, Pfr.; *coarctata*, Pfr.; *turricula*, H. & J.).
 1871. Pse., P.Z.S., pp. 452, 475 (*bursatella*, Gld.; syn. *coarctata*, Pfr.; *streptaxon*, Rve.; *turricula*, H. & J.).
 1876. Pfr., Mon. Hel., vol. vii, p. 255 (syn. *cavernula*, Pfr.; *coarctata*, Pfr.; *turricula*, H. & J.?).
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220 (*Patula streptaxon*).

1881. Clessin, Nomencl., p. 96, ? *cavernula*, H. & J. (Mon. Hel., vol. iii, p. 143); *coarctata*, Pfr. *olim*; *turricula*, H. & J.
 1884. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 34, *coarctata*, Pfr.; *bursatella*, Gld. (part.); *cavernula*, H. & J. (quoting their figure!); *streptaxon*, Rve.
 1887. Tryon, Manual, vol. iii, p. 71, syn. *turricula*, H. & J. (figd., pl. xiii, figs. 79, 80); *streptaxon*, Rve. (figd., pl. xiii, fig. 78); *bursatella*, Gld. (part.); not *cavernula*, H. & J.
 1889. Pætel, Cat., p. 90.
 1894. Pilsbry, Manual, vol. ix, p. 24 (as *coarctata*, Pfr.; syn. *turricula*, H. & J.; *streptaxon*, Rve.).

Hab.—Tahiti. On the ground in forests, north and east side of Moorea (Garrett).

The history of this species is curious. Originally part of Gould's *bursatella*, it was described by Pfeiffer in 1849 as *coarctata*. He then recognized that that name was preoccupied, and abandoned it in favour of *cavernula*, H. & J., a totally different shell. Meantime Hombron and Jacquinot had described it as *turricula* (nom. præoc.) and Reeve under its present name of *streptaxon*, which was forthwith adopted by Pfeiffer himself.

Garrett notes that a "variety (local) occurs which is uniform whitish". The short description given in the *Voyage au Pole Sud* is stated to have been drawn up from the figure only.

8. LIBERA GREGARIA, Garrett.

1884. Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 36, pl. ii, figs. 6, 6a, 6b.
 1887. Tryon, Manual, vol. iii, p. 72, pl. xiii, figs. 83, 84.
 1889. Pætel, Cat., p. 85.
 1894. Pilsbry, Manual, vol. ix, p. 24.

Hab.—South-west part of Moorea.

9. LIBERA RECEDENS, Garrett.

1884. Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 36, pl. ii, fig. 7.
 1887. Tryon, Manual, vol. iii, p. 72, pl. xiii, fig. 85.
 1889. Pætel, Cat., p. 89 (*Pityis*).
 1894. Pilsbry, Manual, vol. ix, pp. 23, 24, pl. ix, fig. 34 (dentition).

Hab.—Moorea (Society Islands).

Garrett states that "the deflection of the last whorl below the periphery of the penultimate whorl, which is an accidental character in some of the species, is *constant* in this".

10. LIBERA HEYNEMANNI, Pfr.

1862. Malak. Blätt., vol. ix, p. 151.
 1868. Pfr., Mon. Hel., vol. v, p. 219.
 1871. Pse., P.Z.S., p. 475 (*Pityis*).
 1874. Cat. Mus. Godeff. (*Patula Heynemanni*, p. 93; *P. Heynemanni*, p. 215).
 1876. Pfr., Mon. Hel., vol. vii, p. 255.
 1879. Kobelt, Jahrb. deutsch. Malak. Ges., p. 220 (*Patula*).

1881. Clessin, Nomencl., p. 96 (no reference to any figure!).
1884. Garrett, Journ. Acad. Nat. Sci. Phil., ser. II, vol. ix, p. 35, pl. ii, fig. 9 (*bursatella*, Gld., part.). He calls attention to the spiral sculpture, no mention of which occurs in Pfeiffer's description.
1887. Tryon, Manual, vol. iii, p. 72, pl. xiii, fig. 82.
1889. Pætel, Cat., p. 85 (*Pityis*).
1894. Pilsbry, Manual, vol. ix, p. 24.
- Hab.*—Tahiti.
- Helix excavata*, H. & J., Voyage au Pole Sud, 1854, p. 17, pl. vi, figs. 9-12.
1862. Gould, Otia, p. 243 (syn. of *bursatella*, Gld.), var. (immature); Conch. Cab., p. 296 (syn. of *Jacquinoti*, Pfr.).
1887. Tryon, Manual, vol. iii, p. 71 (syn. of *Jacquinoti*, Pfr.), pl. xiii, figs. 72-4.
1889. Pætel, Cat., p. 85 (syn. of *Jacquinoti*).
- 1853-81. Pfr., Mon. Hel., as syn. of *bursatella* or *Jacquinoti* (in vol. vii of both!).
1894. Pilsbry, Manual, vol. ix, p. 24 (syn. of *Jacquinoti*).

In the original description there is no mention of any plaits in the mouth, though the figure shows two on the parietal whorl. In the collection in the Paris Museum the specimens so named undoubtedly belong to *L. Heynemanni*, but as they also have specimens named *L. turricula* referable to the same species the evidence is not important. Hombron & Jacquinot's figures of *excavata*, copied by Tryon to illustrate *L. Jacquinoti*, apparently represent a young shell which seems to agree better with *L. Heynemanni* in general characters than with either of the other two species to which it has been at times assigned.

A FURTHER NOTE ON THE ANATOMICAL DIFFERENCES
BETWEEN THE GENERA *CYPRÆA* AND *TRIVIA*.

By H. O. N. SHAW, F.Z.S.

Read 10th December, 1909.

SINCE writing my last paper on *Cypræa* and *Trivia*,¹ in which I endeavoured to show the anatomical differences which I considered sufficient to establish *Trivia* as a genus, Professor W. H. Dall, to whom I am much obliged for his information, has kindly drawn my attention to a further distinction, which I have not noticed in the previous paper. I may mention that the following observations are taken from literature only, as I have not had the opportunity of examining any live specimens. My thanks are due to Mr. E. A. Smith, who, with his usual kindness, has enabled me to verify certain references.

In *Trivia Europæa* (*arctica*), as described by Clark :² "The head is scarcely a projection, concave laterally, flat above, and from its central basal vertical fissure a long proboscis can be exerted, though it is rarely seen." The animal of *Trivia Europæa* (*arctica*) is figured by Forbes & Hanley in their *History of British Mollusca*, 1853, vol. i, pl. NN, figs. 5-7, fig. 7 showing the under surface of head; and the description runs, op. cit., vol. iii, p. 494, "head broad, sublunate; proboscis retractile." H. & A. Adams, in *The Genera of Recent Mollusca*, vol. iii, pl. xxviii, fig. 5, have copied Forbes & Hanley's fig. 5.

Cypræa has, according to Messrs. Adams, op. cit., vol. i, p. 264, "head broad, rostrum short." Troschel, in his *Das Gebiss der Schnecken*, vol. i, pl. xvii, fig. 4, gives a figure of the head of *Cypræa carneola*, and on pp. 202 and 203 op. cit. he differentiates at length between *Cypræa* and *Trivia*. From his remarks and the other works consulted, as Professor Dall observes in his communication to me, it appears that *Cypræa* has a short, stout, subtruncate muzzle, from which a short evertible proboscis may be exerted, whereas *Trivia* has no muzzle, but a long slender proboscis, which, when withdrawn, leaves only a vertical slit between the tentacles on the lower side of the head (see Forbes & Hanley, op. cit., fig. 7). I am informed by Professor Dall that *Trivia Californiana* is very similar to *T. arctica*. The above differences are further proof of the advisability of considering *Trivia* as a genus; in fact, Troschel went so far as to establish a family Triviacea.

¹ Proc. Malac. Soc., vol. viii, pp. 288-313.

² *A History of the British Marine Testaceous Mollusca*, 1855, p. 505.

NOTES ON THE REFERENCES TO CERTAIN GROUPS, ETC., USED
IN THE CLASSIFICATION OF MOLLUSCA.

By H. O. N. SHAW, F.Z.S.

Read 10th December, 1909.

I HAVE recently had occasion to refer to the original descriptions of some of the groups, etc., used in the classification of Mollusca, and found that these references, amongst many others, are seldom quoted in works on classification, and hence considerable time has to be expended, and annoyance is caused, in searching for them. I have verified the following, to which I have had cause to refer, in the hope that they may be of use. My thanks are due to Mr. E. A. Smith and Professor Paul Pelseneer for kindly giving me information with regard to some of them.

1. MOLLUSCA, Cuvier, 1795.

Since the first account of this sub-kingdom does not appear to be much known, being published in a somewhat rare and obscure periodical, I have thought it advisable to give a copy of the original description. Both *Mollusca* and *Gastropoda* (the latter form now admitted more correct than Gasteropoda) have generally, but erroneously, been considered as established in "Tableau élémentaire de l'histoire naturelle des animaux" (1st ed., 1798), Ann. vi.

"Mémoire sur la structure interne et externe, et sur les affinités des animaux auxquels on a donné le nom de Vers; lu à la société d'Histoire-Naturelle, le 21 floréal de l'an 3 [= May 10, 1795], par G. Cuvier." ¹

"En combinant les caractères fournis par les organes de la circulation, et ceux des sentiments, j'ai donc formé six classes dont je vais vous exposer les généralités.

1. *Les Mollusques*. Ils ont un cœur musculaire, fourni de valvules, un système complet de vaisseaux sanguins, et des branchies pour la respiration. Ils ont un cerveau et des nerfs: leurs sens extérieurs sont très-développés dans plusieurs, notamment dans les seiches, qui ont des yeux très-parfaits et des oreilles. Tout leur corps est extrêmement sensible; ils ont une grande puissance musculaire. Il est démontré, pour plusieurs, que leur circulation est double, comme celle des animaux à sang chaud, et des poissons. On n'en connaît encore distinctement aucun où la circulation branchiale ne serait qu'un rameau de la grande circulation, comme il arrive dans les reptiles. Les uns ont les sexes séparés, les autres sont hermaphrodites, et ont besoin d'un accouplement réciproque; enfin, il en a qui sont hermaphrodites, et peuvent produire sans accouplement. Cette classe comprend les *Seiches* et les *Clio*; les *Limax*, et tous les genres voisins du *Limax* tels que *Laplysie*, *Doris*, *Thétis*, et *Patelles*; enfin le genre qui habite les bivalves, dont les ascidies seront les analogues nuds, si, comme le dit Baster, leur intérieur est en tout semblable à celui de l'huître; mais alors il faudra convenir que Bohtsch s'est bien trompé en ne leur accordant qu'un seul intestin qui va d'une de leurs ouvertures à l'autre. Comme je n'ai point encore disséqué d'ascidie, je ne puis décider cette question" (pp. 391, 392).

An account is also given of the following: Crustacés, Insectes, Vers (=vers intestins de Bruguières), Echinodermes, and Zoophytes.

¹ La Décade Philosophique, Littéraire, et Politique, Paris, vol. v, Trimestre 3, 10 Prairial, An iii [= 29 May, 1795], pp. 385-96.

2. PRORHIPIDOGLOSSOMORPHA, Grobben, 1894.

Zur Kenntniss der Morphologie . . . der Mollusken, Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. kl., vol. ciii, p. 86.

3. GASTROPODA, Cuvier, 1795.

Magasin Encyclopédique, 1795, vol. ii, p. 448.

4. STENOGLOSSA, Bouvier, 1887.

Système nerveux . . . des Gastéropodes Prosobranches, Ann. des Sci. Nat., Zoologie, 1887, sér. VII, t. iii, pp. 464, 470.

5. PECTINIBRANCHIA, Cuvier, 1817.

Le Règne Animal, 1817, vol. ii, p. 388, 1st ed. First described as *Pectinibranchiata*.

6. PLAYPODA, Gray, 1857.

As far as I can ascertain this was first employed by Gray in "Guide to the Systematic Distribution of Mollusca in the British Museum", 1857, pt. i, p. 64.

7. TOXOGLOSSA and TÆNIOGLOSSA, Troschel, 1848.

Handbuch der Zoologie, 1848, 3rd ed. First described loc. cit. as *Toxoglossata* and *Tænioglossata*, but changed in later works to above. Troschel derived this name from *τόξον*, since he called the *Toxoglossa* 'Pfeilzungler', which is therefore more correct than the form *Toxiglossa*.

8. CYPRÆIDÆ, Gray, 1824.

Zool. Journ., 1824, vol. i, p. 137. On pp. 71-80 op. cit. it is quoted as *Cypræideæ*, but was emended p. 137.

9. CONIDÆ, Fleming, 1828.

A History of British Animals, 1828, p. 330, 1st ed. Quoted as *Conusideæ*, but as Fleming was the first who used the correct family ending, viz. *-ideæ*, he must be considered the author, although the word has been emended.

A NEW MEXICAN GENUS OF PLEUROCERATIDÆ.

By Professor HENRY A. PILSBRY.

Read 10th December, 1909.†

Among the shells collected by Mr. A. A. Hinkley during his last journey to Mexico (January and February, 1909), were two species of the family Pleuroceratidæ which cannot be referred to any of the known genera. Up to this time no member of this family has been recorded south-west of central Texas, where *Goniobasis convalensis*, Pilsbry, is found in the streams of Hays, Comal, and Bexar counties.¹

LITHASIOPSIS, n.gen.

Shell varying from cylindric with conic spire to ovate-turrite, similar in contour to *Goniobasis* or *Lithasia*, solid. Aperture ovate or piriform, rounded at the base; outer lip thin and acute; columella concave, broad; parietal wall covered with a heavy callus, which is thickest near the posterior angle of the aperture. Operculum very shortly ovate, nearly circular, the nucleus at its lower fourth. Inside there is an oblong dull area of attachment along the columellar side, bounded by a raised border or brown cord; the rest of the inner face being glossy.

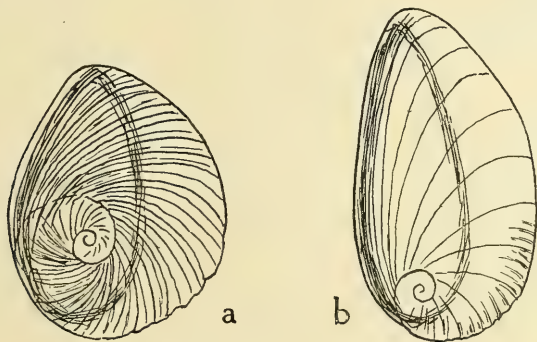


FIG. 1. a, *Lithasiopsis Hinkleyi*; b, *Lithasia obovata*.

Radula similar to that of *Anculosa*. The central tooth is short and wide, with 3, 1, 3 denticles, the body of the tooth smooth below the cusps. The admedian tooth has a very broad, truncate inner cusp and two small outer ones. Its body projects at the lower inner angle. The inner and outer lateral teeth or uncini have five and ten denticles respectively. The shank of the inner uncinus is dilated towards its base.

Type.—*L. Hinkleyi*.

¹ Pilsbry & Fernis, *Mollusca of the South-Western States*, II: Proc. A. N. S. Philad., 1906, p. 167.

Shells of this genus have the heavily calloused inner lip of *Lithasia*, but differ from that genus by the operculum, which in *Lithasia* is oblong with almost basal nucleus (fig. 1*b*, *L. obovata*, Say). Some forms of the heterogeneous group *Goniobasis* have a similar operculum, but they differ by the thin parietal callus. *Lithasiopsis* is not unlike *Melanopsis* in the calloused columella, but it differs in important features of the dentition. In dentition *Lithasiopsis* stands nearest *Anculosa*, which it resembles in having the inner cusp of the admedian tooth enormously developed.

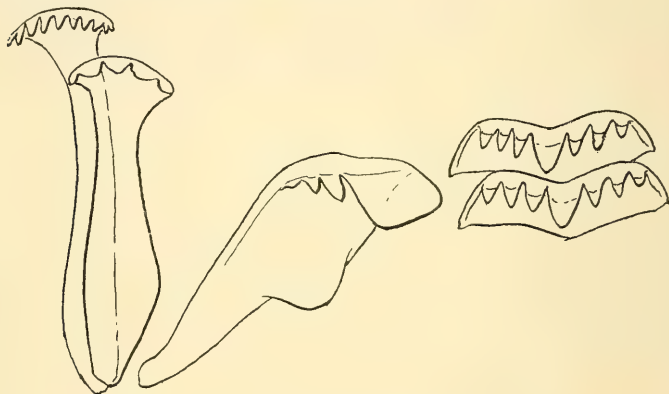


FIG. 2. *Lithasiopsis Hinkleyi*.

Lithasiopsis inhabits streams tributary to the Panuco River. This river system has one of the richest faunas of freshwater shells in Mexico. Mr. Hinkley's researches have brought to light a considerable number of Unionidæ; a fine group of *Pachycheili*, including several globose forms like *Paludomus*; species of *Somatogyrus*, *Amnicola*, *Potamopyrgus*, *Cochliopa*, *Emmericia*, *Pterides*, and *Gundlachia*, etc. Except the Lymnæidæ most of the species are unknown elsewhere, but a few extend as far south as Vera Cruz, and some others north to the Río Grande.

LITHASIOPSIS HINKLEYI, n.sp. Figs. 1*a*, 2, 3.

The shell is cylindric, or oval cylindric, with a short acute spire with concave outlines; solid, dull yellow or greenish-yellow. The first $1\frac{1}{2}$ whorls are smooth, glossy, and convex; the following $1\frac{1}{2}$ to $2\frac{1}{2}$ whorls dull, only slightly convex, showing a keel or thread above or in the suture below. In the typical form the following whorl has an acute median spiral thread. The penultimate and next earlier whorls bear three strong spirals, and these continue upon the last whorl, which has a group of spiral cords at the shoulder, is smooth and flat or concave in the middle, and has weak spiral cords on the base. (In the smooth form the later whorls are without spiral sculpture, and it may be very weak or almost wanting on the spire.)

The aperture usually exceeds half the total length, is ovate or piriform in shape, and white within. The outer lip is thin and sharp, arcuate or straightened; basal margin arcuate. Columella concave. Columellar and parietal margins are covered with a very heavy white callus, which is thickened into a low nodule or pad near the posterior angle of the aperture.

Length 13.8, diam. 7.1 mm.

„	13.5	„	7.9	„
„	12.3	„	6.8	„
„	11.9	„	7	„

The operculum is rounded-ovate, smaller and especially shorter than the aperture.

Hab.—Coy River, a tributary of the Panuco, State of San Luis Potosi, Mexico.

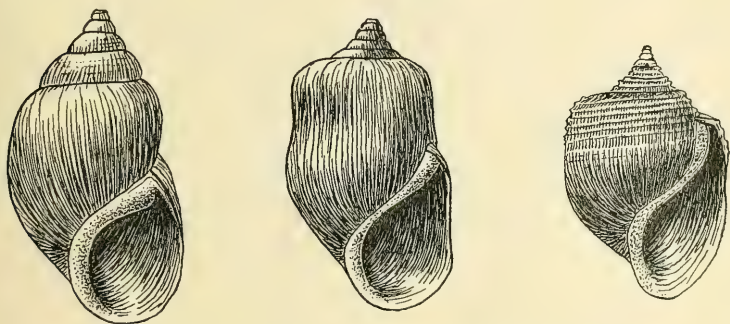


FIG. 3. *Lithasiopsis Hinkleyi*. Two adult and one young example.

This species has much in common with *Lithasia obovata* (Say). The general shape, colour, and columellar callus are similar; but the operculum differs widely. The shape of shell and aperture are remarkably variable, but even in the more ovate and lengthened examples, the last whorl is decidedly shouldered, unlike the following species. As in many Pleuroceratidae, smooth and spirally striate forms coexist in the same colonies.

LITHASIOPSIS MEXICANUS, n.sp. Fig. 4.

The shell is ovate-turrite, with straightly conic spire; solid, lustreless, variously coloured; olive-yellow, uniform or with a blackish olive median band, or purplish black, paler below the suture. The first $2\frac{1}{2}$ whorls are smooth and convex, the following whorls flattened, at first smooth, but about the fifth whorl a few spiral threads appear. These threads continue to the penultimate whorl, where they decrease, leaving the last whorl smooth; or they may persist as very weak angles on the last whorl. Whorls 9 or 10 in complete examples, but the earliest ones are generally worn or eroded in adult individuals. Last whorl convex. Aperture ovate, livid white

or dark inside; outer lip thin and acute, slightly sinuous, advancing slightly below, retracting a little towards the columella and above. Columella concave, broadly white-calloused. Parietal wall in adults covered with a rather thick white callus, heavier towards the posterior or upper angle.

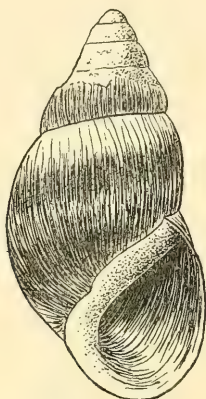


FIG. 4. *Lithasiopsis Mexicanus*, n.sp.

Length 16; diam. 8.2 mm.; aperture 7.8 mm. long.

„	17.5	„	8	„	„	7	„	„
„	15	„	7.3	„	„	6.8	„	„

Operculum like that of *L. Hinkleyi*.

Hab.—Montezuma River, at the ford, a short distance above Tampamolón, State of San Luis Potosí, Mexico.

This species has the appearance of a *Goniobasis*, but differs from that genus by its calloused columella. The dominant colour form is dull yellow, with one or several dusky bands on the last whorl and a bicoloured spire, each whorl light above, dark below; but some examples are uniform yellowish or yellowish brown, and very few (4 per cent. in the lot examined) are purplish or brownish black.

NOTES ON A SMALL COLLECTION OF TERRESTRIAL SHELLS
FROM ANGOLA, WITH DESCRIPTIONS OF NEW SPECIES.

By H. B. PRESTON, F.Z.S.

Read 10th December, 1909.

THE material on which the following notes are based was collected by Dr. W. G. Ansorge at a point about two hundred miles due east of Loanda, in Angola. Considering the enormous area of this Portuguese dependency, comprising as it does some 200,000 square miles of more or less unexplored territory, it is surprising what a very little is at present known of its terrestrial mollusca, as, with the exceptions of Morelet's work¹ and a few scattered papers chiefly concerning non-testaceous molluscs, scarcely any work has hitherto been done with regard to this branch of its fauna. Unfortunately the present collection, doubtless owing to the limited time at the disposal of the collector, is very small; but, though it only includes in all about a dozen species, six of these appear to be new to science.

A part of the collection in question has been acquired by the British Museum and the remainder by myself, and I am much indebted to Mr. Edgar A. Smith for kindly placing in my hands for identification that portion secured by his department, and also for much valuable help in working out the material.

ENNEA ANSORGEI, n.sp.

Shell cylindrically ovate, somewhat thin, glossy, yellowish white; spire moderately obtuse at the apex; whorls 7, convex, sculptured, with oblique, slightly arcuate, closely set, transverse costulæ, the last whorl strangulate; sutures impressed; perforation scarcely apparent; columella broad, oblique; labrum white, polished, expanded, bulging inwards on the right side, the margins connected by a broad, thin,



scarcely perceptible, glossy callus, through which the transverse sculpture is easily visible; the parietal wall bearing on the right side a strong, erect, white, vertical lamella; the outer wall bearing, as the result of strangulation, two strong, white lamellæ; aperture obliquely subquadrate.

Alt. 5.25, diam. maj. 2.75 mm.; aperture, alt. 1, diam. 1 mm.

Hab.—Two hundred miles due east of Loanda, Angola. Type in British Museum.

¹ "Voyage du Dr. Friedrich Welwitsch dans les Royaumes d'Angola et de Benguella," Mollusques, 1868.

The collection included four specimens of this very pretty little species.

ENNEA RINGICULA, Morelet.¹

Two examples were collected, which, though considerably smaller than the type-specimen in the British Museum, after careful examination I am able to refer to this species; they have both been acquired for the national collection.

ENNEA ROSENBERGIANA, n.sp.

Shell ovate, solid, rimate, pale brownish-yellow; spire very obtuse; whorls 8, flat, the first $2\frac{1}{2}$ smooth, the later whorls sculptured with somewhat fine, oblique, closely set, transverse riblets, the last whorl ascending in front, strangulate towards the base; sutures incised, slightly crenellated by the apices of the transverse riblets; umbilicus reduced to an elongate narrow chink; columella slightly oblique, bearing a strong sickle-shaped fold or plait, within the curve of which appears a small denticle; labrum white, polished, expanded, and reflexed, except near the point of insertion with the whorl above, the



margins connected by a broad, shining, parietal callus; parietal wall bearing a single, very elongate, wavily curved lamella, somewhat erect behind, then sloping away, and finally becoming very erect in front; outer wall bearing, as a result of strangulation, two or three revolving lamellæ, the first or upper one being sometimes obsolete or totally absent; aperture irregularly quadrate, the right and left sides sloping towards one another. Alt. 10·5, diam. maj. 5·25 mm.; aperture, alt. 3, diam. 2·25 mm.

Hab.—Two hundred miles due east of Loanda, Angola.

A good series of specimens were collected, which, with the exception of the occasional total or partial absence of the first lamella on the outer wall, show practically no other variation; among these were a number of scarcely half-grown individuals in which the umbilicus is circular, deep, and moderately wide.

Two immature specimens of what would appear to be another form of *Ennea* also occurred, but as they are both obviously only half-grown it would be quite useless to give any detailed description of them.

¹ "Voyage du Dr. F. Welwitsch dans les Royaumes d'Angola et de Benguela," 1868, pp. 80-1.

HELICARION WELWITSCHI, Morelet.

A number of specimens, in all stages of growth, were obtained; they are quite typical, and present scarcely any variation.

HELICARION sp. (?).

Five specimens, probably all immature.

THAPSIA INNOCENS, n.sp.

Shell discoidal, depressed, thin, hyaline, polished, light yellowish-brown horn colour; whorls 8, regularly increasing in size; sutures impressed, narrowly margined below; perforation moderately wide; labrum simple, acute; aperture broadly, obliquely sublunate. Alt. 2.5, diam. maj. 5.25 mm.; aperture, alt. 1.5, diam. 2 mm.



Hab.—Two hundred miles due east of Loanda, Angola.

Eleven specimens; allied to *Helix cerea*, Gould,¹ from Cape Palmas, Liberia, but smaller, darker in colour, more depressed, and rather more closely coiled, the perforation is also wider, and the sutures are narrowly margined, which is not the case with *H. cerea*.

CERASTUS DELICATULA, n.sp.

Shell small, thin, elongately turbinate, pale brown; apex flattened; whorls 7, rather convex, sculptured with fine, closely set, somewhat oblique, transverse costulae, which become obsolete on the base, last whorl bearing a blunt thread-like carina below the periphery; sutures well impressed; umbilicus narrow, deep, partly concealed by the reflection of the columella; columella descending vertically; labrum simple; aperture ovate. Alt. 8, diam. maj. 4.75 mm.; aperture, alt. 3, diam. 2 mm.



Hab.—Two hundred miles due east of Loanda, Angola.

Seven adult specimens and a number of young in various stages of growth. The species may be likened to a miniature *C. Abyssinicus*, Rüppell, from Abyssinia, Central India, etc.

RACHIS ELECTRINUS, Morelet.

One adult and one very immature specimen.

¹ Proc. Bost. Soc. Nat. Hist., 1850, vol. iii, p. 194.

ACHATINA BANDEIRANA, Morelet.

Two specimens of this fine species were secured which agree well with Pfeiffer's figure in the *Novitates Conchologicae*.¹ Morelet's figure² seems to be that of a rather young shell; having had an opportunity of examining the series of this species in the British Museum I think there can be little doubt that *A. Bandeirana* and *A. Dohrniana*, Pfr., are synonymous.

HOMORUS MANUELI, n.sp.

Shell thin, subulate, polished, shining, brown; whorls 12, the earlier whorls mammillary, the later regularly increasing in size, flattish, sculptured with fine transverse costulae which are more in evidence in the sutural regions; sutures impressed, very narrowly margined below; columella whitish, scarcely curved, obliquely truncate, diffused into a thick, well-defined, white, unpolished callus which reaches the lip above; labrum thin, acute; aperture broadly, inversely auriform. Alt. 19, diam. maj. 4.5 mm.; aperture, alt. 3, diam. 1.75 mm.



Hab.—Two hundred miles due east of Loanda, Angola.

The collection included a fine series of this shell, which differs from *Achatina nigella*, Morel.,³ from Pungo Andongo, Angola, about 120 miles to the south-east of the locality whence the present species was obtained, in being considerably larger, having one whorl more, and in the sculpture being much less pronounced; the columella also is not nearly so arched, and is not abruptly truncate as in that species.

PSEUDOGLESSULA MINUSCULA, n.sp.

Shell small, imperforate, dark brown; whorls 9, moderately convex, sculptured with strong, oblique, transverse costulae, the last whorl bearing a subperipheral carina; sutures impressed; columella white, arched, abruptly truncate, a thickish, well-defined

¹ Novit. Conch., vol. iv, pl. cix, figs. 1, 2.

² "Voyage du Dr. F. Welwitsch dans les Royaumes d'Angola et de Benguela," pl. vi, fig. 1.

³ Ibid., pp. 80-1.

callus joining it with the lip above; labrum thin, acute; aperture ovate. Alt. 8.5, diam. maj. 2.5 mm.; aperture, alt. 1.5, diam. 1 mm.



Hab.—Two hundred miles due east of Loanda, Angola.

Type in British Museum.

A very beautiful little species, of which only two specimens were obtained, both being in the British Museum.

AFERULUS INTERMEDIUS, Martens,¹ var. *ANGOLENSIS*, n.var.

Separable from the typical form by its closer coiling, narrower body-whorl, somewhat wider and more circular aperture, and by the reflection of the columellar lip; though banded it is also separable from the var. *cingulatus*, Dupuis & Putzeys,² by the above characters. Alt. 15 mm., diam. maj. 17, min. 13 mm.; aperture, alt. 9, diam. 8.5 mm.

Hab.—Two hundred miles due east of Loanda, Angola.

The above variety is described largely upon geographical grounds; the species would appear to have a very wide range; the typical form from Uganda is unicolorous, though the banded form described as var. *cingulatus*, from Nsendwe on the Upper Congo, also occurs in the former region. Taking into account its present occurrence within 200 miles of the Atlantic seaboard it would thus seem to range some 1400 miles in a west-south-westerly direction.

Among other specimens of the genus in the British Museum are two sets, one from Uganda, the other from Ruwenzori, labelled *A. elatior*, v. Mrts.³ After a careful examination I cannot but think, however, that these are other than *A. intermedius*, var. *cingulatus*; the latter set have been recently recorded under the name of *elatior* in Mr. E. A. Smith's paper on the Ruwenzori Expedition.⁴

¹ Von Martens in Deutsch Ost Africa, vol. iv, p. 8.

² Bull. Soc. Roy. Malac. Belgique, 1901, pp. xli, xlii.

³ Sitzungsberichte der Ges. naturf. Freunde zu Berlin, 1892, p. 180.

⁴ Trans. Zool. Soc. London, vol. xix, pt. i, p. 47.

NOTES ON THE FAMILY AMPULLARIIDÆ.

By G. B. SOWERBY, F.L.S.

(Continued from vol. viii, p. 362.)

Read 14th January, 1910.

Sub-genus PILA, Boltén.

Pila, Mus. Bolt., 1798, p. 145.*Ampullaria*, Lamarek, Prodrôme, p. 76 (*ex parte*).*Pachystoma*, Guilding, Zool. Journ., 1828, vol. iii, p. 536.*Pachylabra*, Swainson, Malac., 1840, p. 339.*Pomus*, Gray, Proc. Zool. Soc., 1847, p. 148.Type.—*Helix ampullacea*, Linn.

107. AMPULLARIA ADUSTA, Reeve.

Conch. Icon., sp. 11.

A. pilula, Reeve, Conch. Icon., figs. 12, 36.

Hab.—Zanzibar.

Comparing Reeve's types of *adusta* and *pilula* I am quite unable to separate them.

108. AMPULLARIA AFRICANA, von Martens.

S.B. Nat. Fr. Berlin, 1886, p. 112.

Hab.—Nyassa.

109. AMPULLARIA ALUCINANS, n.sp. p. 63.

110. AMPULLARIA AMPULLACEA (Linn.).

Helix ampullacea, Linn., Syst. Nat., p. 1244.*Nerita ampullacea*, Müller, Hist. Verm., p. 172.*Ampullaria ampullacea*, Reeve, Conch. Icon., sp. 48.*A. fasciata*, Roissy, 1805 (*vide* "Hist. Nat. générale et particulière des Moll.").*A. fasciata*, Lamarek, Anim. sans Vert., 1819, vol. vi, p. 177.*A. Celebensis*, Quoy et Gaim., Voy. de l'Astrol., vol. iii, p. 167, pl. lvii, figs. 1-4.*A. expansa*, Nevill (as var. of *conica*).*A. Gruneri*, Philippi, Conch. Cab., p. 37, pl. ix, fig. 8.*A. magnifica*, Dunker, Conch. Cab., p. 64, pl. xxi, fig. 1.*A. ochracea*, Jay, Cat., pl. iii, fig. 8.*Pomacea orbata*, Perry, Conchology, 1811, pl. xxviii, No. 5.*A. Sumatrensis*, Phil., Conch. Cab., p. 57, pl. xix, figs. 1, 2.

Hab.—Siam, Java, Sumatra, Borneo, etc.

It is difficult to define the limits of this species. Some of the names quoted as synonyms simply refer to immature shells, while others refer to fully developed shells quite inseparable from *A. ampullacea*. There are others, such as *Perakensis*, De Morgan, *Wellesleyana*, De Morgan, *turbinis*, Lea, and *Dalyi*, Blanford, which would perhaps more properly be regarded as varieties or synonyms, but, being in some doubt, I think it best at present to include them in the list as species.

111. AMPULLARIA APERTA, Philippi.

Zeits. Mal., 1849, p. 18: Hanley & Theobald, Conch. Ind., pl. cxv, fig. 4 (as *A. saxea*, var.).

Hab.—Pegu, Akyab, Pongday.

The specimens figured for this species in Reeve's Conchologia Iconica are not Philippi's *A. aperta*, but a South American species named by Nevill *A. (Pomus) erronea*.

112. AMPULLARIA BALANOIDEA, Gould.

Bost. Soc. Nat. Hist., 1850, vol. iii; Reeve, Conch. Icon., sp. 129; Petit, Journ. de Conch., vol. ii, p. 26.

Hab.—Liberia.

113. AMPULLARIA BEGINI, Morlet.

Journ. de Conch., 1889, vol. xxxvii, p. 184, pl. viii, fig. 1.

Hab.—Cambodia.

114. AMPULLARIA BILINEATA, Reeve.

Conch. Icon., sp. 110.

Hab.—?

115. AMPULLARIA CECILLEI, Philippi.

Zeits. Malak., 1848, p. 191.

A. inops, Morelet, Rev. Zool., 1851.

Hab.—Madagascar.

116. AMPULLARIA CHEVALIERI, Germain.

Bull. Mus. Paris, vol. x, p. 469.

Hab.—Chari Region.

117. AMPULLARIA COMPACTA, Reeve.

Conch. Icon., figs, 62, 71.

A. paludinoïdes, var., Hanley & Theobald, Conch. Ind., pl. xiv, fig. 7.

Hab.—Malacca, Mandalay, Tenasserim, etc.

I place *A. paludinoïdes* as a variety of *A. conica*, and it is quite possible that *A. compacta*, and also the following species, *A. complicata*, may merge into the same, but the specimens I have seen at present seem fairly separable.

118. AMPULLARIA COMPLICATA, Reeve.

Conch. Icon., sp. 89.

Hab.—"Philippines" (?).

See note on *A. compacta*.

119. AMPULLARIA CONICA, Gray.

Wood's Index Test. Supp., 1828; Hanley, Conch. Misc., pl. iii, fig. 13; Reeve, Conch. Icon., sp. 10.

The following, which have been described as different species, I regard as varieties:—

Var. *Borneensis*, Philippi, Conch. Cab., p. 31, pl. viii, fig. 3.

Hab.—Borneo, Singapore, etc.

Var. *Javanica*, Reeve, Conch. Icon., sp. 96.

Hab.—Java.

Var. *lubrica*, Reeve, Conch. Icon., sp. 61.

Var. *orientalis*, Philippi, Zeits. Malak., 1848.

Var. *scutata*, Mousson, Moll. Java, 1849 = *sulcata*, Mousson.

Hab.—Java.

Var. *Stoliczkana*, Nevill, Cat. Moll. Ind. Mus., 1877, fasc. E.

Hab.—Penang.

Var. *turbinoides*, Reeve, Conch. Icon., sp. 37.

120. AMPULLARIA DALYI, Blanford.

Proc. Malac. Soc., 1903, vol. v, p. 281, pl. viii, fig. 1.

Hab.—Siam.

Blanford thinks this probably a sub-species of *turbinis*, Lea, distinguished by the absence of transverse colour-bands, and the presence of rather peculiar raised longitudinal streaks. Perhaps this and *turbinis* may be considered varieties of *A. ampullaria*, but the specimens I have seen seem fairly separable.

121. AMPULLARIA DECOCTA, Mabille.

Bull. Soc. Malac. France, vol. iv, p. 155.

Hab.—Tonkin.

122. AMPULLARIA DIRA, Reeve.

Conch. Icon., sp. 125.

Hab.—?

123. AMPULLARIA EXIGUA, Philippi.

Conch. Cab., p. 46, pl. xiii, fig. 4.

Hab.—Egypt (Pæstel, Catalogue).

124. AMPULLARIA FULIGINEA, Philippi (Koch).

Conch. Cab., p. 53, pl. xvi, fig. 6.

Hab.—Madagascar.

125. AMPULLARIA GLOBOSA, Swainson.

Zool. Illus., ser. i, pl. cxix; Philippi, Conch. Cab., p. 8, pl. i, fig. 3;
Reeve, Conch. Icon., figs. 46, 47.

Hab.—Calcutta, Bengal, Orissa, etc.

Var. *cinerea*, Reeve, Conch. Icon., sp. 94; Hanley & Theobald, Conch. Ind., pl. cxiii, fig. 1.

Hab.—Ceylon (Reeve).

Shell smaller than the typical *globosa*, of an ash tint with colour-bands.

Var. *corrugata*, Swainson, Zool. Illus., ser. i, pl. cxx; Hanley & Theob., Conch. Ind., pl. cxiii, fig. 2. = *A. rugosa*, Sowb., Gen. of Shells.

Var. *encaustica*, Reeve, Conch. Icon., sp. 76.

A small form, somewhat anteriorly attenuated, and with a less prominent spire than the type.

Var. *incrassatula*, Nevill, Moll. Ind. Mus. Calcutta, 1884, pt. ii, p. 2.

Hab.—Calcutta.

Var. *longispira*, Nevill, Moll. Ind. Mus. Calc., 1884, pt. ii, p. 2.

Var. *sinistrorsa*, Nevill, Cat. Moll., July, 1877, fasc. E, p. 2.

Hab.—Calcutta.

Var. *spherica*, Hanley & Theobald, Conch. Ind., pl. cxiii, fig. 4.

Hab.—Moradabad.

An *A. globosa* with colour-bands figures in the Conch. Indica (pl. cxiii, fig. 5) as var. *fasciata*, but it is not *A. fasciata*, Lamarek (= *ampullacea*).

126. AMPULLARIA GORDONI, Smith.

Ann. Mag. Nat. Hist., 1892, vol. x, p. 382.

Hab.—Victoria Nyanza.

127. AMPULLARIA GRACILIS, Lea.

Proc. Acad. Nat. Sci. Philad., vol. viii, p. 110.

Hab.—Siam.

128. AMPULLARIA GRADATA, Smith.

Proc. Zool. Soc., 1881, p. 289, pl. xxxiii, fig. 22.

Hab.—Between Nyassa and east coast of East Central Africa.

129. AMPULLARIA LARGILLIERTI, Philippi.

Zeits. für Malak., 1848, p. 192; Conch. Cab., pl. xiii, fig. 5.

= *A. filosa*, Reeve, Conch. Icon., sp. 88.

Hab.—Madagascar.

Reeve (Conch. Icon., fig. 109) has mistaken a variety of *A. virens* for this species.

130. AMPULLARIA LEOPOLDVILLENSIS, Putzeys.

Proc. Soc. Malac. Belg., vol. xxvii, p. 98.

Hab.—Leopoldville, Congo.

131. AMPULLARIA LETOURNEUXI, Bourguignat.

Descrip. div. ésp. Moll. de l'Egypte, etc., 1879, p. 27.

Hab.—Victoria Nyanza.

Von Martens has placed this as a synonym of *A. adusta*, Reeve, but having seen Bourguignat's type I cannot recognize it as such. The shell is slightly compressed at the suture, and rather acuminate at each end.

132. AMPULLARIA LUZONICA, Reeve.

Conch. Icon., sp. 26.

Hab.—Luzon.

133. *AMPULLARIA MADAGASCARIENSIS*, Smith.
Proc. Zool. Soc., 1882, p. 384, pl. xxii, figs. 8, 9.

Hab.—Madagascar.

134. *AMPULLARIA MÆSTA*, Reeve.
Conch. Icon., sp. 92.

Hab.—Ceylon.

135. *AMPULLARIA NIGRICANS*, n.sp. p. 63.
Hab.—Buddu, Uganda.

136. *AMPULLARIA NYANZÆ*, Smith.
Ann. Mag. Nat. Hist., 1892, vol. x, p. 382.
Hab.—Victoria Nyanza.

137. *AMPULLARIA OCCIDENTALIS*, Mousson.
Journ. de Conch., 1887, vol. xxxv, p. 299, pl. xii, fig. 9.

Hab.—Kunene, South Africa; Dongwenna, Angola (in shallow swamp).

138. *AMPULLARIA OLEA*, Reeve.
Conch. Icon., sp. 102.
Hab.—Penang; Tongking.

139. *AMPULLARIA OVATA*, Olivier.
Voy. Emp. Ottom., 1804; Reeve, Conch. Icon., sp. 64.

The following I regard as synonyms:—

A. Bourguignati, Billotti, Bull. Soc. Malac. Fr., 1855, p. 107, pl. vii.

Hab.—Lake Ballat, Isthmus of Suez.

The specimen in Bourguignat's collection is in bad condition, almost bleached, but it shows very faint colour-bands.

A. Bridouxi, Bourg., Hist. Malac. du Lac Tanganyika, vol. i, p. 72, pl. v, fig. 22.

A decorticated shell of the form of *Kordofana*, showing strong colour-bands.

A. Dumesmiliana, Billotti, Amp. Afr. in Bull. Soc. Malac. Fr., 1885, p. 105, pl. vi, fig. 2.

This is simply a young specimen of *ovata*.

A. lucida, Parr., Jay Cat., p. 282.

A. Raymondi, Bourg., Moll. Nouv., 1863, p. 76, pl. ix, fig. 4.

Type in a bleached, chalky condition.

Var. *Kordofana*, Parreys; Philippi, Conch. Cab., p. 44, pl. xiii, fig. 1.

Differs from the typical *A. ovata* in its broader, rather oblique form, and its more or less roughly plicate surface. Specimens in Bourguignat's collection representing *ovata* and *Kordofana* present such differences that it is no wonder they have been regarded as distinct species, but intermediate forms show the connexion.

Hab. (*A. ovata* and varieties).—Egypt, Nubia, Abyssinia, Lake Tanganyika, Isthmus of Suez, etc.

140. AMPULLARIA PALUSTRIS, Morelet.

Journ. de Conch., 1864, vol. xii, p. 158.

Hab.—Lake Ebrie, near Senegal.

141. AMPULLARIA PERAKENSIS, De Morgan.

Bull. Soc. Zool. France, 1885, vol. x, p. 418.

Hab.—Perak.

142. AMPULLARIA SAXEA, Reeve.

Conch. Icon., sp. 108; Hanley & Theobald, Conch. Indica, pl. cxv, fig. 3 (fig. 4 represents *A. aperta*, Philippi, a different species).

Hab.—Pegu, etc.

Var. *nux*, Reeve, Conch. Icon.

I am unable to find any important difference between this and *saxea*.

143. AMPULLARIA SPECIOSA, Philippi.

Zeits. Malak., 1849, p. 18; Conch. Cab., pl. xi, fig. 2; Reeve, Conch. Icon., sp. 33.

A. canaliculata, Reeve, Conch. Icon., sp. 79 (as of Lamarck).

Hab.—Zanzibar.

144. AMPULLARIA SUBSCUTATA, Mousson.

Journ. de Conch., 1882, vol. xxx, p. 46, pl. iii, fig. 6.

Hab.—Madagascar.

145. AMPULLARIA THEOBALDI, Hanley & Theobald.

Conch. Indica, pl. cxv, fig. 2.

Hab.—Pegu.

146. AMPULLARIA TURBINIS, Lea.

Proc. Acad. Nat. Sci. Philad., 1856, p. 288.

Hab.—Siam.

Var. *erythrocheila*, Dautzenberg & Fischer, Journ. de Conch., 1905, p. 426.

Hab.—Mekong à Chandoc.

Var. *subampullacea*, Nevill, Moll. Ind. Mus. Calcutta, pt. ii, p. 6.

Var. *subglobosa*, id., op. cit.

Hab.—Perak.

There is little beyond the depression of the spire to distinguish *A. turbinis* from *A. ampullacea*, and it is with some doubt that I keep them separate. The difference, however, as far as my observation goes, seems to be fairly constant.

147. AMPULLARIA VIRENS, Lamarck.

Anim. sans Vert., 1819, vol. vi, p. 179.

A. carinata, Swainson, Zool. Illus., ser. II (*non* Lamarck); Reeve, Conch. Icon., sp. 58; Hanley & Theobald, Conch. Ind., pl. cxiv, fig. 1; Philippi, Conch. Cab., pl. i, fig. 2.

A. Largillierii, Reeve, Conch. Icon., sp. 109 (*non* Phil.).

Hab.—Cochin, Bombay, Pondicherry, Ceylon, etc.

The following I regard as varieties :—

Var. *Layardi*, Reeve, Conch. Icon., figs. 24 and 40.

Hab.—Ceylon.

A more globose form and darker-coloured.

Var. *Malabarica*, Philippi, Conch. Cab., p. 29, pl. vii.

Hab.—Malabar.

Lighter colour and substance, spire rather more elevated, umbilicus narrower.

Var. *Maura*, Reeve, Conch. Icon., sp. 57.

Hab.—Assam.

Mouth stained with dark purple, otherwise same as type.

Var. *pallens*, Philippi, Conch. Cab., p. 32, pl. viii, fig. 4.

Var. *paludinoïdes*, Philippi (Christofori & Jan), Conch. Cab., p. 27, pl. vii, fig. 4.

The shell figured in the Conch. Ind. (pl. cxiv, fig. 7) as a variety of *paludinoïdes* is *A. compacta*, Reeve.

Var. *Fischbeini*, Dohrn, Proc. Zool. Soc., 1858.

Hab.—Ceylon.

Transversely banded, and spotted on the lip.

148. *AMPULLARIA VITTATA*, Reeve.

Conch. Icon., sp. 78.

Hab.—Philippines (Reeve).

149. *AMPULLARIA WELLESLEYENSIS*, De Morgan.

Bull. Soc. Zool. France, 1885, vol. x, p. 419.

Hab.—Wellesley Province, Malay Peninsula.

150. *AMPULLARIA WERNEI*, Philippi.

Conch. Cab., p. 19, pl. v, fig. 4 ; pl. xvii, fig. 2.

Hab.—White Nile.

151. *AMPULLARIA WINKLEYI*, Pilsbry.

Acad. Nat. Sci. Philad., 1901, p. 187.

Hab.—Burma.

152. *AMPULLARIA WOODWARDI*, Dohrn.

Proc. Zool. Soc., 1858, p. 134.

Hab.—Ceylon.

Sub-genus *SAULEA*, Gray.

Saulea, Gray, Proc. Zool. Soc., 1867.

153. *AMPULLARIA VITREA* (Born).

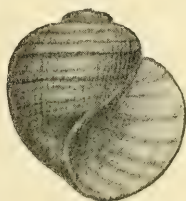
Test. Mus. Vindobon., pl. xv, figs. 15, 16 ; Reeve, Conch. Icon., sp. 80.

Hab.—Sierra Leone, Liberia, West Africa.

DESCRIPTION OF NEW SPECIES.

AMPULLARIA ALUCINANS, n.sp.

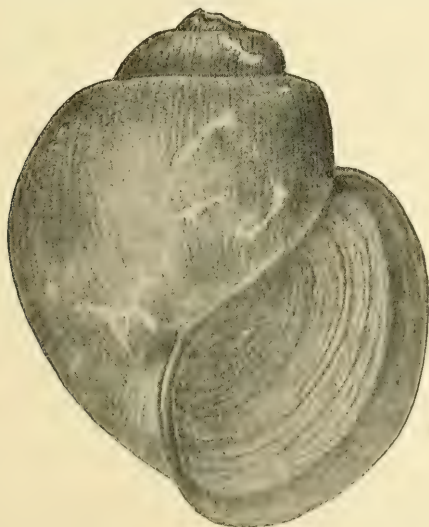
Testa late turbinata, mediocriter umbilicata, fusco-olivacea, fasciis numerosis angustis nigro-fuscis ornata, longitudinaliter irregulariter plicata et striata, striis transversis subtilissimis decussata; spira brevis; anfractus convexi, supra planulati; ultimus latiusculus, superne rotunde angulatus, supra angulum leviter depressus, infra angulum rotunde convexus, basim versus leviter contractus; apertura latiuscula, intus fasciata; peristoma tenue. Long. 23, diam. 23 mm.; apertura, long. 22, lat. 12 mm.

*Hab.*—Ceylon.

This species might easily be mistaken for the Brazilian *A. decussata*, Moricand, to which it bears a remarkably close resemblance. Its transverse striæ are, however, much less conspicuous, and it is, of course, far removed from that species by its eastern habitat and shelly operculum.

AMPULLARIA NIGRICANS, n.sp.

Testa ovata, anguste umbilicata, ubique nigro-olivacea, nitens, longitudinaliter irregulariter vix conspicue plicata, et subtilissime



striata; spira elatiuscula; anfractus rotunde convexi, superne obtuse angulati, ad suturam sublate depressi; ultimus ventricosus; apertura ovata, mediocriter lata, intus violacea, versus marginem nigrescens; peristoma tenue, haud reflexum. Long. 52, lat. 54 mm.; apertura, long. 45, lat. 27 mm.

Hab.—Buddu, Uganda, 4000 feet.

This species is distinguished by its very dark colouring. It has much the same form as the typical *A. ovata*, but more depressed at the suture. It is somewhat similar in appearance to *A. papyracea*, Spix, from Meobamba.

ERRATA.

Vol. viii, p. 351. For *Ampullaria Hopetonensis*, Lea, read *A. paludosa*, Say, New Harmony Diss., 1829, vol. ii, p. 260, and place *A. Hopetonensis*, Lea, 1839, in the synonymy.
p. 352. Remove *A. paludosa* from the synonymy of var. *Dysoni*.

I am indebted to Mr. Bryant Walker, of Detroit, Michigan, for this correction. In giving the date of the publication of Say's *Ampullaria paludosa* as 1840, I find I was referring to a reprint, the name having been published in 1829 as a substitute for *A. depressa*, preoccupied by Lamarck for a fossil species. It is not the variety named by Hanley *Dysoni*, but the typical form named by Lea *Hopetonensis*.

DESCRIPTIONS OF NEW SPECIES OF *DONOVANIA*, *PISANIA*,
PHENACOLEPAS, AND *FISSURELLA*.

By G. B. SOWERBY, F.L.S.

Read 14th January, 1910.

DONOVANIA FASCIATA, n.sp.

Testa ovato-turrita, imperforata, albida, rufo-fusco lineata; spira elata, vix convexa; anfractus 6, convexi, liris 2, rufo-fuscis conspicue nodulosis ornati, aliter spiraliter minus conspicue noduloso-lirati; ultimus $\frac{1}{2}$ longitudinis testæ æquans, convexus, basim versus rufo-fusco quadrilineatus; apertura parva, ovata; peristoma crassiusculum, fusco notatum; columella brevis, rectiuscula; canalis brevissimus, mediocriter latus. Long. 6, diam. $1\frac{1}{4}$ mm.



Hab.—Gorée, West Africa.

Distinguished by having, on a white ground, two conspicuous nodulous reddish-brown ridges on each whorl, and four narrow lines of the same colour at the base of the body-whorl. Several specimens of this pretty little species were found in the collection of the late Mons. Albert Denans, labelled "petits buccins de Gorée".

The Mediterranean species of this little group, named by Bucquoy, Dautzenberg, and Dollfus "*Donovania*" (= *Lachesis*, Risso), bear a strong similarity one to another, whereas this West African species has a very different aspect. Mons. Dautzenberg, to whom I submitted specimens, agrees with me as to its generic position.

PISANIA LIROCINCTA, n.sp.

Testa elongato-ovata, fulvescens, fusco irregulariter flammulata; spira elata, leviter convexa; anfractus convexo-declives, primi 3-4 longitudinaliter nodoso-costati, spiraliter fusco lineati, deinde spiraliter lirati, liris latiusculis, leviter planulatis; anfractus ultimus oblongus, convexus; rostrum breviter recurvum; apertura latiuscula; columella leviter sinuosa, infra medium obscure uniplicata; peristoma acute dentatum; canalis brevis, latiusculus. Long. 33, diam. 15; apertura, long. 17, lat. 6 mm.

Hab.—?

This shell bears a strong resemblance in form and colouring to *P. picta*, Reeve (*Buccinum*). Its chief distinguishing feature is found

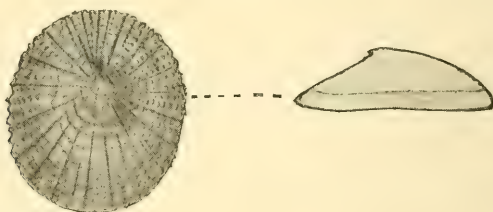
in the spiral ridges of the three last whorls, the upper whorls being longitudinally plicate and granose.



The only two specimens I have seen have been in our possession for many years, and I have no information as to their habitat.

PHENACOLEPAS MIRABILIS, n.sp.

Testa ovato-subcircularis, depressiuscula, albida, versus marginem pallide fulvo-fusco zonata, antice mediocriter arcuata, postice oblique declivis, costellis numerosis noduloso-aculeatis radiantibus, et liris concentricis cancellata, liris angustis, supernis subdistantibus, infernis coarctatis; apex depresso inclinatus, circiter $\frac{1}{2}$ post medium longitudinis situs; pagina interna albida, radiatim costellata, sublate albo marginata, ad marginem crenulata. Long. 25, lat. 22, alt. 8 mm.



Hab.—Australia?

This handsome shell is of an unusually large size for the genus; it differs from *P. crenulata*, Brod., in its depressed form, and in the position of the apex, which is less posterior and much less elevated and curved. The concentric liræ are rather distant towards the apex, and gradually become more crowded towards the margin. I have no certain information as to its habitat, but these specimens were recently submitted to me by Mr. H. McClelland, who informs me that he received them with a lot of Australian shells.

The generic name *Phenacolepas*, Pilsbry, takes the place of *Scutellina*, Gray (preoccupied).

FISSURELLA (CREMIDES) KEPPELIANA, n.sp.

Testa oblonga - ovalis, elata, albida, nigro interruptim radiata, costellis numerosis irregularibus nodulosis radiantibus instructa;

foramen magnum, oblongum, coarctatum, paulo ante medium situm ; pagina interna alba, ad marginum acute crenulata, limbo orificii cæruleo-albo, anguste nigro marginato. Long. 26, lat. 17, alt. 14 mm.

Hab.—Sierra Leone.

This shell has an orifice very like that of *F. alabastrites*, Reeve, from the Cape Verd Islands, but it is of a much more elevated form, and has a much larger number of radiating ribs, which are narrower and closer. *F. Humphreysi*, Reeve, has the same elate form, but a smaller orifice, the interior border of which is white without the dark ring.



F. glaucopis, Reeve, another species of the group, has a more depressed form and a smaller orifice. Neither of these forms shows any trace of the interrupted black rays characteristic of the new species. A number of specimens of this species were collected at Sierra Leone by the late Admiral Keppel ; they vary somewhat in elevation, and in the number, closeness, and nodulosity of the ribs ; but all are characterized by the black rays, and by the dark ring bordering the pale, blue limbus beneath the orifice.

ON MARINE MOLLUSCA FROM THE KERMADEC ISLANDS, AND
ON THE '*SINUSIGERA APEX*'.

By TOM IREDALE.

Read 14th January, 1910.

DURING the major portion of the year 1908 I was on Sunday Island, the only habitable island of the Kermadec Group. I was endeavouring to make a representative collection of the molluscan fauna. Unfortunately the nature of the seas around the island counteracted my efforts to such an extent that I can only claim to give a glimpse of this very interesting fauna. I say very interesting, as, though the geographical position of the island promised that the forms would repay study, I did not even anticipate such results as I have obtained, sanguine as I was. From the nature of the flora of Sunday Island, and because it was politically a part of the Dominion, the group has been zoologically attached to New Zealand.

The land molluscs on record showed, however, little affinity, whilst the very few marine forms previously obtained were almost all additions to the New Zealand list.

I propose to give some idea of the island, collecting-grounds, and reasons for the poverty of the collection made. Sunday Island is, roughly speaking, 600 miles north-east of New Zealand, the same distance east of Norfolk Island, and south of Tonga, which are the nearest land points. It is a volcanic crater apparently rising out of a great depth. It is irregularly triangular in shape, a deep bay making the west coast, the north coast being mostly sand and boulders, whilst the east and south, forming the third side of the triangle, were boulder beaches. Towards the north end of the east coast was a shallow bay, which was the only littoral workable portion of the coastline. The prevailing winds were east and west, the former from October to April, the latter the remainder of the year. Both these made the north coast unworkable, but all the molluscan life had years before been driven into deeper water, so that not much regret was felt about this. The west bay was gravel, the two ends being boulders. The terrific force of the westerlies prevented molluscs from existing within their reach, so that nothing practically lived within 5 fathoms save among the boulders, where they were not obtainable by any ordinary means.

The south coast was as barren as the north, whilst the southern end of the east coast was similar. This left the northern end of the east coast as the only place where shore-collecting could be carried out. This was also a boulder formation, but, protected to a certain extent by the islets, a few molluscs could be obtained by hard work. This consisted of wading and lifting the stones by means of crowbars. Under stones easily lifted nothing was the general result.

That littoral collecting would be poor had been anticipated, but

good results were hoped for from a study of the chart by means of dredging.

The south and south-east coasts sheer down immediately, off the south-east corner over 200 fathoms being plumbed within a quarter of a mile of land, whilst a few miles off over 5000 fathoms are obtained. The south coast varies from 50 to 150 fathoms quite close in. The whole of the west bay, however, is under 30 fathoms, steepening immediately outside the points. The north coast runs out under 30 fathoms for about 2 miles, and then sheers down. The east coast inside the islets is about the same depth, dropping immediately adjacent to the islets to great depths. For the purpose of studying this shallow water an oil launch was taken. Upon arrival at the island, however, it was found that there was no landing-place on the north or east coasts, the only course being to pull the launch up on the west coast. The slightest wester, rushing right into the bay, prohibited its launching. Consequently it was scarcely used. This was the more aggravating as the very few hauls gave promise of a peculiarly rich fauna. When out in the launch, by means of the sea-telescope the bottom could be examined to a depth of over 10 fathoms.

Close to the rocky shore the boulders continued to about that depth. Magnificent algæ monopolized these boulders for about 3 fathoms, then succeeded coral of many hues and weird shapes. Attempts to drag pieces up resulted in loss of dredges, such few pieces as were obtained urging to further efforts. By carefully hunting the beach a few specimens were collected, but usually the force of the waves left only fragments to denote the nature of the animal. One of the islands off the north-east corner had a nice littoral collecting-ground, but this we were prevented from studying on account of the westerlies. I got one or two good molluscs there, not otherwise obtained.

On the wave-swept boulders lived four or five Limpets, four Chitons, a couple of *Siphonaria*, *Nerita melanotragus*, Smith, *Thais Smithi*, Braz., and *Planaxis Brasilianus*, Lam.

The sub-littoral fauna was characteristic. By sub-littoral I mean forms which lived so near low-water mark they could be procured by wading, and at the bottom of rock-pools. The commoner sub-littoral forms were mostly novel, the rarer forms being stragglers from deeper water, and usually belonging to species of widespread distribution. To the former belonged five more Chitons, an *Emarginula*, a *Fissurellidea*, a big *Trochus* near *pyramis*, Born, a *Clanculus*, a *Gena*, a *Trivia*, a *Pisania*, a *Cantharus*, and a fine *Conus*. The latter included *Angaria tyria*, Reeve, *Thais chaidea*, Duclos, *T. succincta*, Lam., *Argobuccinum australasia*, Perry, *Septa rubicunda*, Perry, *Epitonium perplexum*, Pease, *Columbella versicolor*, Sowb., *Conus minimus*, Linn., *Umbraculum umbella*, Martyn, *Arca Domingensis*, Lam., *Codakia bella*, Conrad, *Lasæa miliaris*, Phil., and *Modiolus auriculatus*, Kr. Here also were found quite commonly Aplysioids of various genera which have not yet been studied. A few Pleurobranchs, and very rarely an odd Nudibranch, turned up, with a few *Umbraculum umbella*, Mart. None of these shells was abundant, all required much searching for,

and I conclude these had probably only very recently established themselves from the following facts. Most of this category were found living adjacent to the north-east corner. This appeared to be the landing-place of these visitors. Small colonies of *Tectarius Feejeensis*, Rve., *Melina nucleus*, L., and *Gadinia conica*, Angas, there alone lived, whilst in the pools the fry of *Meleagrina vulgaris*, Schum., kept casually appearing. An odd specimen of *Nerita plicata*, L., was once found, and one day a stray *Litorina Mauritian*a, Q. & G., settled there.

The shells most frequently met with dead on the beach belonged to this same class. Such were *Cerithiopsis sinon*, Bayle, *Polinices simia*, Desh., *Cymatium Spengleri*, Gmel., *C. exaratum*, Rve., *C. labiosum*, Wood, *Cassidea cernica*, Sowb., *Alectrion spiratus*, A. Ad., *A. gaudiosus*, Hinds, *Lyria nucleus*, Lam., *Terebra venosa*, Hinds, *Bullaria ampulla*, Linn., *Placunanomia ione*, Gray. From pieces of coral pulled out of 6 to 9 feet, at dead low water, were obtained *Coralliophila monodonta*, Q. & G., and *Magilus antiquus*, Montf.

As Hedley notes that the pelagic fauna was scarcely represented at Funafuti, and I observe Melvill & Standen record none from Lifu, it is interesting to note that pelagic forms were not uncommonly met with on the beaches. Four species of *Ianthina* and one of *Recluzia*, as well as many Pteropods, were picked up, the former being alive. On some days the cast-up *Ianthina* and *Verella* made a blue line on the sand. With these shell-bearing pelagic forms also occurred the Nudibranch *Glaucus*, and one or two Eolids came up on driftwood and pumice. Shells of *Spirula spirula*, L., were not uncommon, and, in the spring, a few *Argonauta argo*, L., and *A. nodosa*, Sol., came to land. From logs cast up on the beach species of *Nausitoria* and *Xylophaga* were extracted, as well as one specimen of *Saxicava arctica*, L.

Both Hedley from Funafuti, and Melvill & Standen from Lifu, record an overwhelming majority of Gastropods over Pelecypods. The same occurred here. No bivalves really lived in the littoral or sublittoral zones, the forms collected there being stragglers. Furthermore, very few were dredged, and these were all small things. However, a valve of *Lutraria oblonga*, Gmel., an undetermined *Macra*, a fragment of a big *Pecten*, valves commonly of a fine *Spondylus* and *Chama* point to some good finds yet to be made in this direction.

Owing to the importance of this collection to students of Zoogeography, it is very necessary that the species be accurately determined. Inasmuch as the majority of the shells obtained are minute and of Indo-Polynesian affinities, it will be some time before even the small number I got will be correctly worked out. Furthermore, I have found great difficulty in generically locating such well-known species as *Drupa* (?) *chaidea*, Duclos, and *Galeropsis* (?) *monodonta*, Q. & G.

I am herewith giving a short list of species certainly identified, with a few notes on some interesting shells, and remarks on the '*Sinusigera apex*'. I wish to acknowledge the invaluable aid that has been given me by Mr. Charles Hedley, of the Australian Museum, Sydney, and Mr. E. A. Smith, of the British Museum.

1. *Helcioniscus craticulatus*, Suter.
2. *H. dirus*, Rve.
3. *Ancistromesus Kermadecensis*, Pils.
4. *Angaria tyria*, Rve.
5. *A. distorta*, Linné.
6. *Leptothyra picta*, Pease.
7. *Nerita melanotragus*, Smith.
8. *N. plicata*, Linné.
9. *Littorina Mauritanica*, Q. & G.
10. *Tectarius Feejeensis*, Rve.
11. *Planaxis Brasilianus*, Lam.
12. *Rissoa carnosus*, Webster.
13. *R. candidissima*, Webster.
14. *Rissoina polytropus*, Hedley.
15. *R. plicata*, A. Adams.
16. *Cerithiopsis sinon*, Bayle.
17. *Strombus aratus*, Mart.
18. *S. urceus*, Linn.
19. *S. elegans*, Sowb.
20. *Xenophora corrugata*, Rve.
21. *Hipponix foliacea*, Q. & G.
22. *Natica sagittata*, Menke.
23. *N. orientalis*, Gmel.
24. *Polinices simia*, Desh.
25. *Ianthina ianthina*, Linné.
26. *I. umbilicata*, d'Orb.
27. *I. exigua*, Lam.
28. *I. globosa*, Swain.
29. *Recluzia Hargravesi*, Cox.
30. *Cypræa erosa*, Linné.
31. *C. caputserpentis*, Linné.
32. *Erato lachryma*, Gray.
33. *E. corrugata*, Hinds.
34. *Trivia Napolina*, Kiener.
35. *Septa rubicunda*, Perry.
36. *Argobuccinum australasia*, Perry.
37. *A. siphonatum*, Rve.
38. *A. papilla*, Wood.
39. *Cymatium Spengleri*, Gmel.
40. *C. Dunkeri*, Lischke.
41. *C. caudatum*, Gmel.
42. *C. exaratum*, Rve.
43. *C. costatum*, Born.
44. *C. labiosum*, Wood.
45. *C. vespaceum*, Lam.
46. *C. Parkinsonia*, Perry.
47. *Cassidea pyrum sophia*, Braz.
48. *C. cernica*, Sowb.
49. *Dolium pomum*, Linné.
50. *D. perdix*, Linné.
51. *Architectonica cingula*, Kien.
52. *Helicacis variegatus*, Gmel.
53. *H. stramineus*, Gmel.
54. *Epitonium perplexum*, Pease.
55. *Atlanta fusca*, Eydoux & Souleyet.
56. *Colus toreuma*, Mart.
57. *Mitra mitra*, Linné.
58. *M. carbonaria*, Swainson.
59. *M. lanceolata*, Herrier.
60. *Alectrion spiratus*, A. Ad.
61. *A. gaudiosus*, Hinds.
62. *A. scalaris*, A. Ad.
63. *Thais chaidea*, Duclos.
64. *T. succincta*, Lam.
65. *T. Smithi*, Braz.
66. *Columbella versicolor*, Sowb.
67. *Lyria nucleus*, Lam.
68. *Coralliophila neritoidea*, Lam.
69. *C. nivea*, A. Ad.
70. *C. Lischkeana*, Dunk.
71. *C. monodonta*, Q. & G.
72. *Magilus antiquus*, Montf.
73. *Marginella mustelina*, Angas.
74. *Turris cingulifera*, Lam.
75. *Terebra venosa*, Hinds.
76. *Conus vermiculatus*, Lam.
77. *C. minimus*, Linné.
78. *Pugnus parvus*, Hedley.
79. *Bullaria ampulla*, Linn.
80. *Bullina scabra*, Gmel.
81. *Limacina bulimoides*, d'Orb.
82. *Styliola subula*, Q. & G.
83. *Clio pyramidata*, Br.
84. *C. acicula*, Rang.
85. *C. virgula*, Rang.
86. *Cuvierina columnella*, Rang.
87. *Carolinia tridentata*, Gmel.
88. *C. trispinosa*, Lesueur.
89. *C. longirostris*, Lesueur.
90. *C. inflexa*, Lesueur.
91. *Umbraculum umbella*, Mart.
92. *Siphonaria Diemenensis*, Q. & G. (?).
93. *S. atra*, Q. & G.
94. *Gadinia conica*, Angas.
95. *Placunanomia ione*, Gray.

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| 96. <i>Arca foliata</i> , Forsk. | 109. <i>Diplodonta Zelandica</i> , Gray. |
| 97. <i>A. Domingensis</i> , Lam. | 110. <i>Lasæa miliaris</i> , Phil. |
| 98. <i>Lima bullata</i> , Born. | 111. <i>Ervilia biscalpta</i> , Gld. |
| 99. <i>Philobrya costata</i> , Bern. | 112. <i>Chione toreuma</i> , Gld. |
| 100. <i>Modiolus auriculatus</i> , Krauss. | 113. <i>Lutraria oblonga</i> , Gmel. |
| 101. <i>Lithophaga straminea</i> , Dunk. | 114. <i>Saxicava arctica</i> , Linné. |
| 102. <i>Septifer bilocularis</i> , Linné. | 115. <i>Gastrochæna Retzii</i> , Desh. |
| 103. <i>Modiolaria impacta</i> , Herrm. | 116. <i>Chama foliacea</i> , Q. & G. |
| 104. <i>Meleagrina vulgaris</i> , Schum. | 117. <i>Nautilus pompilius</i> , L. |
| 105. <i>Melina nucleus</i> , Linné. | 118. <i>N. macromphalus</i> , Sowb. |
| 106. <i>Julia exquisita</i> , Gld. | 119. <i>Spirula spirula</i> , L. |
| 107. <i>Spondylus ostreoides</i> , Smith. | 120. <i>Argonauta argo</i> , L. |
| 108. <i>Codakia bella</i> , Conrad. | 121. <i>A. nodosa</i> , Sol. |

HELClONISCUS CRATICULATUS, Suter.

Helcioniscus craticulatus, Suter, Proc. Malac. Soc., 1905, vol. vi, p. 352, figs. in text.

On the rocks at the Kermadecs, between tide-marks, five species of Limpets live. The big *Ancistromesus* is abundantly distinct, whilst two others appear to be local in their distribution. The remaining two are exceedingly plentiful, and fine typical specimens are very easily differentiated. These occupy rather different stations, one living nearer low tide than the other. About half-tide, however, they intermingle, and both species there are small. Shells so collected were studied by Suter, so that the description contains characters of both. I am, therefore, herewith drawing up an amended description of *craticulatus*, Suter, which name I restrict to the species dwelling higher up from low tide. The figures and type measurement agree with that species.

Shell oval, anteriorly scarcely narrowed, apex about the anterior third, anterior slope straight, posterior slope slightly convex. Margin scarcely crenulate. Finely ribbed, ribs between forty and fifty slightly more prominent than a remaining similar number. In young shells these ribs almost appear beaded, owing to the concentric lines of growth. Colour externally orange to brownish, with or without darker markings or streaks. Inside the spatula is brown, with a central white oval spot which generally increases with age. Specimens which are marked outside with dark radiating lines show these inside, otherwise below the spatula is pale orange, iridescent. Young shells are naturally more depressed than older ones.

Largest specimen, length 34, breadth 30, height 15 mm.

Medium ,, ,, 26 ,, 21 ,, 8 ,,

NERITA PLICATA, Linné.

Nerita plicata, Linné, Syst. Nat., 1758, 10th ed., p. 779.

In the Index Faunæ Novæ Zealandiæ appears *Nerita undata*, L., under which name a shell of the above species is in the Canterbury Museum. I can trace no record otherwise for New Zealand, save this Kermadec shell. One specimen only was collected alive on the rocks at the north-east corner of Sunday Island.

ARGOBUCCINUM SIPHONATUM, Reeve.

Ranella siphonata, Reeve, Proc. Zool. Soc., 1844, p. 138; Conch. Icon., pl. vii, fig. 38.

Under the name *Tutufa* (*Crossata*) *Californica*, Hinds, Suter has recorded this shell from the Kermadecs (Trans. N. Zeal. Inst., 1905 (1906), vol. xxxviii, p. 328). I have compared the shells I collected with the shell in the Auckland Museum upon which Suter based his record, and they are undoubtedly the same, and are as certainly Reeve's *siphonatum*.

ARGOBUCCINUM PAPILLA, Wood.

Murex papilla, Wood, Index Test. Supp., 1828, p. 14, pl. v, fig. 2.
Ranella verrucosa, Sowb., Conch. Illus., *Ranella*, 1836, p. 8, fig. 20; Kiener, Coq. Viv., 1841-2, p. 24, pl. xiv, fig. 1; Reeve, Conch. Icon., pl. v, fig. 24; Tryon, Man. Conch., ser. I, vol. iii, pp. 39, 279, pl. xxi, fig. 27.

A unique shell of unknown habitat in the British Museum was figured by Wood. Eight years later this same specimen was given a new name and refigured by Sowerby. Kiener, Reeve, and Tryon have reproduced Sowerby's figures and name, and ignored Wood's figure. Tryon reduced it to a synonym of *eruentata*, Sowb., but it is a very distinct and easily recognizable form. It was constantly occurring in a very much damaged state on the beach of Sunday Island, but no live specimens were obtained.

CYMATIUM LABIOSUM, Wood.

Murex labiosus, Wood, Index Test. Supp., 1828, p. 15, pl. v, fig. 18.
Triton Strangei, Ad. & Ang.: Smith, Proc. Zool. Soc., 1878, p. 816, pl. 1, fig. 16.

The latter name was reduced to a synonym by Tryon (Man. Conch., ser. I, vol. iii, p. 17), and in this case this course is justified. Specimens collected at Sunday Island were identified by Mr. Hedley as the shell known to him as *Strangei*, Ad. & Ang., and they are undoubtedly the same as *labiosus*, Wood.

CASSIDEA CERNICA, Sowerby.

Cassis cernica, Sowb., Proc. Zool. Soc., 1888, p. 211, pl. xi, fig. 19.

On the beach occurred rarely specimens of a small *Cassidea*, usually very imperfect. One was washed up alive, but in that case the shell was badly smashed. Examination of the literature showed nothing exactly like it, but in the British Museum specimens of the above species agreed perfectly, though the figure did not. It was described from Mauritius, which is an immense distance from Sunday Island. The species of the genus *Cassidea* seem very imperfectly known, as Melvill (Journ. Conch., 1905, vol. ii, pp. 176 seq.), writing of them as *Casmaria*, H. & A. Ad., only included two species with perhaps four sub-species. In that paper he overlooked this species, making no reference whatever to it.

EPITONIUM PERPLEXUM, Pease.

This species has already been recorded from the Kermadecs by Suter (Journ. Malac., 1899, vol. vii, p. 54), under the name of *Scalaria australis*, Lam.

IANTHINA UMBILICATA, d'Orb.

D'Orbigny described this species (Voy. Amér. Mérid., 1847, p. 414, No. 319), carefully comparing it with *exigua*, Lam., the preceding species, of which he wrote: "Cette espèce habite tout l'océan Atlantique dans les régions chaudes," and of this he stated: "Elle se trouve encore dans les mêmes circonstances." Yet Reeve (Conch. Icon., 1858, pl. v, figs. 22a-b, sp. 22) refers to it as a manuscript name of d'Orbigny's in the British Museum, attached to a shell of unknown habitat. Tryon includes it doubtfully as a synonym of *exigua*, Lam. (Man. Conch., vol. ix, p. 38, pl. x, figs. 21, 22).

It would appear to be a rare shell. I have seen specimens in the British Museum from the Sandwich Islands and North Pacific, as well as my Kermadec specimens. It has the form of *exigua*, Lam., but, being destitute of the rough sculpture of that shell, has a shiny appearance, and immediately attracts attention. The striæ are very fine, no more pronounced than in *globosa*, Swainson.

Tryon allows as varieties of *I. ianthina*, L., *planospirata*, Ad. & Rve., *trochoidea*, Rve., and *britannica*, Leach. I should suppress all three. If varieties are required, the most depressed form is *depressa*, Rve., and the most conoidal, *trochoidea*. This is from an examination of all Reeve's types.

ON THE 'SINUSIGERA APEX'.

Kesteven dealt with the history of the *Sinusigera* apex up to 1901 (Proc. Linn. Soc. N.S.W., 1901, vol. xxvi, pp. 533 seq.). After having shown that *tritoniformis*, Blain., should be classed as a *Purpura* as it had a *Sinusigera* apex very like that of *succincta*, Lam., and that the only two *Sinusigera* embryos previously followed to their adult stage had been shown to belong to *Purpura*, he wrote: "I do not expect the embryo of every *Purpura* to be of the *Sinusigera* type, but every embryo of the type to be that of a *Purpura*." Hedley, in 1903 (Mem. Aust. Mus., vol. iv, p. 383), endorsed this opinion by describing, as a new species of *Purpura*, a young shell with a beautifully sculptured *Sinusigera* apex dredged in deep water off New South Wales. Two years later he pointed out that this was the young of a *Coralliophila* (Rec. Aust. Mus., 1906, vol. vi, p. 219). In the same paper (p. 217) he records a new species of *Bittium* with a similar apex, writing: "The presence of a *Sinusigera* protoconch is of interest, but we have not sufficient data to now discuss its teleological significance." These destroyed Kesteven's conclusions, but I still consider the presence of a *Sinusigera* apex will aid in classifying shells into groups, if not genera. I would not class in the same group a shell with such an apex with a shell with a different apex, and would rewrite Kesteven's dictum thus: "I *do* expect the embryo of every *Purpura* (or any other sectional name) to be of the

Sinusigera type." To know whether a shell possesses a *Sinusigera* apex very young shells must be collected either alive or dead. Many shells possess such apices, but in adult specimens the characters are so obscure that it cannot be recognized. Moreover, it is very often tilted, and the latter whorls make the claw unrecognizable. A shell with a *Sinusigera* apex will be of widespread distribution, and, vice versa, many shells, widely distributed, will be found to owe their range to their *Sinusigera* youth.

The most common Purpuroid on Sunday Island was a beautiful little shell described by Suter as a sub-species of *Purpura striata* under the title *Bollonsi* (Trans. N. Zeal. Inst., 1905 (1906), vol. xxxviii, p. 331). Later he extended its range to New Zealand, but transferred it to *Drupa*, giving it specific rank (Proc. Malac. Soc., 1909, vol. viii, p. 254, pl. xi, figs. 5-7). He states in his description, "protoconch minute." Many shells were collected by me, young shells with the protoconch, as well as old ones showing variation of shape and form. Living on the wave-swept boulders they were very stumpy, the spire scarcely raised, and the mouth very heavily armoured. Constantly being knocked off and smashed, they all showed repairs, and it was noted that the new shell never had nodulous sculpture, the characteristic of the adult. Shells living in sheltered places had fine spires, being long and narrow, and the aperture not very strongly toothed. This series made the shell easily recognizable as that figured by Brazier from Lord Howe Island (Mem. Aust. Mus., 1889, vol. ii, p. 28, pl. iv, figs. 1-4, 7-12, 21, 22). The twelve figures there given are very good, though reversed. No description was offered. Brazier called it *Purpura Smithi*. Kesteven, in the paper first quoted, gave a description of this shell, but placed it as a variety of *Purpura tritoniformis*, Blain., with which, in my opinion, it has less affinity than with *Purpura striata*, Martyn, with which Suter first associated it. The shell is certainly a valid species, and is close to the latter species. I do not consider it a *Drupa*. The apical characters are: Five-whorled, *Sinusigera* in form, red-brown in colour, paler towards the apex, the last two whorls keeled at the periphery, with faint wrinkle sculpture longitudinally, only showing in fresh specimens. It is usually tilted.

Hedley has described the apex of *Purpura pseudamygdala* "of the *Sinusigera* type, broad, with rounded whorls, brown, smooth, and glossy" (Proc. Linn. Soc. N.S.W., 1903, vol. xxvii, p. 599). When Kesteven treated of the apices of *tritoniformis*, Blain., and *succincta*, Lam., he noted that *Purpura neglecta* was generically separable. Later he described its apex, showing it to consist of one and a half whorls indistinctly marked off (Proc. Linn. Soc. N.S.W., 1901, vol. xxvi, p. 714, pl. xxxvi, fig. 2), and included it in *Sistrum*. There was no doubt this was unsatisfactory, so Hedley (Proc. Linn. Soc. N.S.W., 1908, vol. xxxiii, p. 456) suggested it might be referred to *Kalydon* of Hutton. He overlooked the fact that *neglectum* is a very close ally of *scobina*, Q. & G., with similar apical characters, which is as unhappily placed in *Purpura*, but which is certainly not referable to *Kalydon*. I have seen no specimens of *Drupa* showing the apical

characters, but shall anticipate the existence of *Sinusigera* apices in that genus.

A rare Purpuroid on Sunday Island was a shell similar in general appearance to figures of *amygdala*, Kiener, and *pseudamygdala*, Hedley. It was immediately recognized by Mr. Hedley as *Drupa chaidea*, Duclos (Ann. Sci. Nat., 1834, p. 106, pl. i, fig. 4). Young in all stages were collected, and half-grown specimens agreed perfectly with Pease's figure of *Sistrum rugulosum* (Amer. Journ. Conch., 1869, vol. iv, p. 93, pl. xi, fig. 7), which Tryon had already referred to this species (Man. Conch., 1880, vol. ii, p. 187). Why this shell should be classed as a *Drupa* puzzled me, the only similar shell in that group being Blainville's *elatum*, which seemed also to me incorrectly placed. It was therefore pleasing to find Hedley, when he restored to the latter its Linnean designation *mancinella*, also transferred it to *Thais* (Proc. Linn. Soc. N.S.W., 1908, vol. xxxiii, p. 457). To that genus, using the name in its present broad sense, I would allot *chaidea*, Duclos. I find that this shell has a *Sinusigera* apex, five-whorled, shining white, smooth, and more genteel in form than *Smithi*, Braz. I do not doubt that such an apex will be found attached to *mancinella*, Linné.

I have noted that Hedley has described the apex of *Coralliophila Lischkeana*, Dunker, as *Sinusigera* in form. In that case the apex is very heavily sculptured, and it may be that such apices exist throughout the genus *Coralliophila*. I have seen apices in Sunday Island dredgings which agree perfectly with Hedley's description and figure (Mem. Aust. Mus., 1903, vol. iv, p. 382, fig. 96). I do not see any reason to doubt the existence of this beautiful *Coralliophila* in Sunday Island waters. An apex with an even more beautifully sculptured *Sinusigera* apex is followed by a half-whorl of sculpture which shows it to be either *Coralliophila nivea*, A. Ad., or a very close ally.

Quoy & Gaimard's *monodonta*, to which is united Sowerby's *madreporarum*, was referred by H. & A. Adams to *Coralliophila*. Pease, on account of its habits, placed it in *Rhizochilus*, but though it lives on coral, in exactly the same manner, I do not think it can be correctly there placed. I do not expect to find a *Sinusigera* apex attached to *Rhizochilus*. Tryon referred *monodonta* to *Galeropsis* (Man. Conch., 1880, vol. ii, p. 212, pl. lxxvii, figs. 389-91, 398), and was followed by Hedley (Mem. Aust. Mus., 1899, vol. iii, p. 461). Melvill and Standen placed it in *Coralliophila* again (Journ. Conch., 1895, vol. viii, p. 110), and that place is probably correct. Young shells from dredgings show it to have a heavily sculptured *Sinusigera* apex.

So far, except the *Bittium*, all the *Sinusigera* apices have belonged to *Purpura*, *Drupa* (?), and *Coralliophila*. Searching through Sunday Island dredgings I came across a beautiful young shell showing a *Sinusigera* apex, which was clearly referable to *Alectrion*. It was only an odd shell, but as young shells which I had recognized as *gaudiosus*, Hinds, were at hand, I examined them, and found that they were undoubtedly also *Sinusigera* in form. Other odd young shells, specifically separable, but unidentifiable, had also similar

apices. In these the *Sinusigera* character is obscured, owing to the similarity in colour of the apex to the adult shell. One young one which was traced to *spiratus*, Adams, was, however, whitish, followed by a pink post-embryonic shell. I allude to these further in the succeeding notes. A shell which appears to be novel and referable to *Cantharus* has a *Sinusigera* apex, almost indistinguishable from that possessed by *Thais chaidea*, Duclos. From that character I conclude, if this shell is new, that it will not be long before it is again recorded, and perhaps from some far distant locality.

From these instances it will be seen that the *Sinusigera* is certainly represented in many genera, as widely understood at present. I should therefore state that no species should be allotted to a group of which the type has been shown to possess a *Sinusigera* apex, unless it also possess such an apex. And I would anticipate that all such groups will later be raised to the rank of genera. It is also possible in the latter case that differences in the *Sinusigera* will be useful in group-classifying. The discovery of the *Sinusigera* in the Alectrionidæ appears to me especially important, as such an aid may considerably reduce the work necessary in the revision of the species of that puzzling family. I have only seen one species of *Arcularia* possessing an apex, and though that was not perfect it was sufficient to decide it was not of the *Sinusigera* type. Deep-water species of *Alectrion*, from figures, do not seem to have *Sinusigera* apices.

ALECTRION GAUDIOSUS, Hinds.

Nassa gaudiosa, Hinds, Voy. Sulphur, 1844, p. 36, pl. ix, figs. 16, 17.
N. zonalis, A. Ad.: Suter, Trans. N. Zeal. Inst., 1905 (1906), vol. xxxviii, p. 331.

Under *gaudiosa*, Hinds, many names are grouped by Tryon, and amongst these is *zonalis*, A. Ad. The shells I collected on Sunday Island agree well with Hinds' type, and disagree with Adams' types. This species was rarely cast up on the beach, and young shells occurred in dredgings. From these the characters of the apex were obtained: four-whorled, rapidly increasing, shining, smooth, *Sinusigera* in form, the upper half dark brown, the lower half pale fawnish. This *Sinusigera* is more globular than those belonging to Purpuroid shells.

ALECTRION SPIRATUS, A. Adams.

Nassa spirata, A. Ad., Proc. Zool. Soc., 1851, p. 106.

A shell commoner than the preceding upon the beach agreed with shells from Lord Howe Island and also New South Wales. In the Australian Museum such shells were labelled *glans*, L., but with this determination I disagree. My specimens were found to coincide with the types of *spirata* from Swan River, West Australia. It is worth describing in detail: Protoconch *Sinusigera* in form, whitish, of four whorls, rapidly increasing, shining; this is usually missing from adult shells. The next two whorls are bright pink, each sculptured by about fourteen longitudinal ribs which are overridden by four spiral cords. In the next whorl these spirals fade away and vanish, and on the succeeding whorls the longitudinals follow their example, and

on the fifth adult whorl show only as nodules on the shoulder. The most extraordinary feature is the disappearance of the pink colour, which is replaced by creamy white, marked with longitudinal zigzag dashes of brown. As indicated above, the whorls are shouldered. The mouth is unarmoured. It is an easily recognizable shell by means of its pink tip and zigzag markings.

Another species, of which I have not the adult, has a *Sinusigera* more erect, and, though the post-embryonic sculpture is very similar, it is pure white. It is possible in this shell the sculpture may be retained on the later whorls. Another species, of which I possess no adults, has a shining, white, semi-globular *Sinusigera*, followed by a white shell, of which only the succeeding two whorls are faintly longitudinally ribbed, the third whorl showing no sculpture.

Alectrion spiratus, Adams, has been referred to *elegans*, Kien. (Coq. Viv., 1834, p. 56, pl. xxiv, fig. 97), but is easily separated from that shell, as known to me by figures, by the armoured mouth of the latter, as well as colour and sculpture.

SIPHONARIA DIEMENENSIS, Q. & G.

The first *Siphonaria* from the Kermadecs were recorded under the above name by Suter (Trans. N. Zeal. Inst., 1906 (1907), vol. xxxix, p. 295), with Hedley's concurrence. The numerous specimens I collected all varied, but were quite unlike typical *Diemenensis*, and Mr. Hedley, upon the quantity I showed him, would have preferred to attach them to *exulorum*, Hanley, a species described from Norfolk Island. To me they differed quite as much from that species. I do not intend to describe them, yet feel they are unsatisfactorily placed at present. A second species was found which I have referred to *atra*, Q. & G., upon Mr. Hedley's initiative. This is a much smaller shell than *atra* usually is, but does not disagree so decidedly as the former with its position. The perplexing feature of these shells is that beach specimens could not be made to coincide with either of the above two forms. A few live shells were found living on the big *Ancistromesus*, which seemed quite distinct, but I cannot think three species of *Siphonaria* can exist on such a small island. These shells varied in almost all the characters which have been used as differential features in the previous naming of *Siphonaria*, and the examination of figures of so-called species left me in despair.

GADINIA CONICA, Angas.

Gadinia conica, Angas, Proc. Zool. Soc., 1867, pp. 115, 220, pl. xiii, fig. 27.

G. pentagoniostoma, Sowb. : Angas, Proc. Zool. Soc., 1867, p. 220.

G. conica, Angas : Dall, Amer. Journ. Conch., 1871, vol. vi, p. 11.

G. Angasii, Dall, loc. cit.

Siphonaria albida, Angas, Proc. Zool. Soc., 1878, pp. 314, 869, pl. xviii, figs. 14, 15.

Gadinea nivea, Hutton, Journ. de Conch., 1878, vol. xxvi, p. 36 ;
Man. N. Zeal. Moll., 1880, pp. 37, 202 ; Trans. N. Zeal. Inst.,
1882 (1883), vol. xv, p. 144, figs. i-v.

On Sunday Island, Kermadec Group, I collected live as well as dead specimens of a *Gadinia*. Anyone who has met with a colony

of live *Gadinias* will have noted the extraordinary shapes they assume, as cramped for room they grow together. When unrestricted, low, flat, beautifully centred stars are found, then high conical and lop-sided forms, according to the space available. The Sunday Island specimens were compared with specimens of *nivea* from Lyttelton Harbour, and also in Otago, where the type was collected, and they were found to be inseparable. As Hutton had stated he was not satisfied that his species was distinct from *conica*, Angas, I took my specimens to Sydney with me. The common New South Wales species I collected both alive and dead, and found it quite indistinguishable from these shells. That species was known as *Angasii*, Dall, and in this identification Mr. Hedley agreed. The history of this name is quite interesting. In 1867 Angas described a species of *Gadinia* as *conica*, and also included in his Port Jackson List of Mollusca *pentagoniostoma*, Sowb., and quoted as reference to Sowerby's species *Conch. Ill.* But no such name appears in that work. Carpenter, in his "Mazatlan Shells", 1856, had referred a Mazatlan species to Sowerby's name, but could not find where Sowerby had used the name. Apparently it was only a manuscript name. Dall, on account of this prior use by Carpenter, gave the name *Angasii* to Angas's second species, pointing out that it might be only the adult form of *conica*, as the types of that species seemed small and immature. In 1878 Angas described from St. Vincent's Gulf, South Australia, a white *Siphonaria* as *albida*. Mr. Hedley pointed out that this might be a synonym.

I have examined the types of *conica*, also the shells from Port Jackson labelled *pentagoniostoma*, Sowb., by Angas, and consequently those upon which Dall founded his *Angasii*, also the type of *albida*, as well as other Australian and New Zealand specimens, together with my own from New South Wales, New Zealand, and the Kermadecs, and find that they must all be referred to one name, and that is *conica*, Ang.

PHILOBRYA COSTATA, Bern.

Philobrya costata, F. Bern., Bull. Nat. Mus., 1896; Journ. Conch., 1897, vol. xlv, p. 15, pl. i, fig. 5; p. 33, fig. 7.

P. Filholi, Bern., 1897, loc. cit., p. 16, fig. 1(?); p. 13, pl. i, fig. 6.

That *Filholi*, Bern., is the young of *costata*, Bern., seems certain from the study of the figures quoted. Bernard's description upholds this view, as he gives *exactly* all the same measurements for his two species, which is palpably inconsistent with the diagnoses of the species. As the figures show *Filholi* to be a smaller shell than *costata*, and he states "toutes les figures sont grossies 12 fois", I conclude the measurements are incorrect.

My Kermadec shells were mostly valves, only a few complete young shells being found. Some agreed perfectly with Bernard's figure of *Filholi*, though others varied slightly from the figures. Some beautiful pink valves were noted. Hedley (Proc. Linn. Soc. N.S.W., 1906, vol. xxx, p. 544, pl. xxxii, figs. 14, 15) has given figures of the young and adult of his *parallelogramma*, which seem quite comparable with Bernard's figures of his *Filholi* and *costata*.

NOTES ON A COLLECTION OF HELICOID LAND SHELLS FROM NEW GUINEA.

By G. K. GUDE, F.Z.S.

Read 14th January, 1910.

SINCE collecting Mollusca and other Natural History objects in New Guinea in 1902 and 1903, Mr. A. E. Pratt has made two further expeditions to this, the largest island in the world. The first of these started from the south coast with the object of penetrating into the interior of Dutch New Guinea, and unfortunately proved a complete failure through his inability to procure native porters. On his latest expedition to North and West New Guinea Mr. Pratt obtained extensive collections, and the Mollusca were, with one or two exceptions, in excellent condition. Some species were represented by considerable numbers, and those enumerated below were collected at Hamatawarea, near Fak-Fak, West New Guinea. With one exception they all belong to known forms, no less than seven of the species pertaining to the genus *Papuina*, one of these being new to science.

XESTA CITRINA, Linn., var. OBIANA, Mlldff.

Xesta Obiana, Mlldff., Nachr. Blätt. Deutsch. Malak. Ges., 1902, p. 186.

Originally described as a distinct species, allied to *X. aulica*, by Möllendorff, but it appears to me to be simply a depressed small form of *X. citrina*. Hitherto only recorded from the island Obi in the Moluccas.

HEMIPLECTA ANDAIENSIS, Smith.

Ariophanta (Hemiplecta) Andaiensis, Smith, Proc. Malac. Soc., 1897, vol. ii, p. 287, pl. xvii, figs. 7, 8.

One specimen is larger than the type, measuring diam. maj. 35, min. 30 mm.; alt. 14.5 mm. Another specimen is still more depressed than the one figured by Mr. Smith in Ann. Mag. Nat. Hist., 1897, ser. vi, vol. xx, pl. ix, fig. 4, its dimensions being: diam. maj. 32.5, min. 28.5 mm.; alt. 12 mm.

HEMIPLECTA DORÆ (Tapp.-Can.).

Nanina Doræ, Tapp.-Can., Ann. Mus. Civ. Genova, 1880, vol. xvi, p. 61; 1883, vol. xix, p. 202, pl. v, figs. 8-10.

Nanina (Hemiplecta) Doræ, Kobelt, Conch. Cab., *Helix*, 1902, Abth. v, p. 1001, pl. cclix, figs. 7-9.

The specimens obtained are larger and more elevated than the type. Diam. maj. 46, min. 38 mm.; alt. 22 mm.

HEMIPLECTA CAIRNSI, Smith.

A single immature shell.

HEMIPLECTA (?) FOULLIOYI, Le Guill.

A large series of this fine species was collected, including several immature specimens, in various stages of growth, which are carinated, the keels disappearing when about $4\frac{1}{2}$ whorls have been completed.

The mature shells are all larger than the type from Triton Bay, which is stated to measure: diam. 46, alt. 29 mm., whereas my largest specimen has the following dimensions: diam. maj. 57.5, min. 47.5 mm.; alt. 32 mm.; while the smallest measures: diam. maj. 48, min. 41.5 mm.; alt. 29 mm. Some shells have a sharply defined infra-peripheral, broad, dark olivaceous zone, occupying quite half of the base, the remainder being pale olivaceous. The parietal callus of the mouth is minutely granulated, a feature to which no reference appears to have been made by any previous observers. The only figures published of the species are in the Conch. Cab., *Helix*, 1900, Abth. v, p. 999, pl. celix, figs. 1-3.

The generic position of this species is uncertain. Described by Le Guillou as *Helix*, and referred by Gray and others to *Nanina*, it was placed in *Hemiplecta* by Pfeiffer and Tapparone-Canefri, while Kobelt doubtfully assigned it to *Xesta*. Fortunately, Mr. Pratt brought a specimen with the whole animal preserved in alcohol, and as Mr. Burne has kindly undertaken to investigate its anatomy it is anticipated that all doubt in this respect will shortly be cleared up.

CALYCIA CRYSTALLINA, Rve.

Several specimens.

CHLORITIS PERVICINA, Smith.

Ann. Mag. Nat. Hist., ser. VI., vol. xx, p. 411, pl. ix, figs. 8-10.

One specimen is a trifle smaller than the type. Diam. maj. 26.5, min. 22 mm.; alt. 13.5 mm.

ALBERSIA TENUIS, Pfr.

A large series of specimens in beautiful condition was obtained. The species appears to be very stable, varying but little either in form, colour, or texture. In size the range is also inconsiderable, the largest shell being 35 mm. in diameter and the smallest 31 mm., while in height they vary from 23.5 to 27 mm.

At first it was thought to be an undescribed form, as, on comparison with *A. tenuis*, the periostracum, which under a strong lens appears of a beautiful silky texture, showed considerable difference, exhibiting undulating, obliquely descending wrinkles, but on closer scrutiny the type of *A. tenuis*, to which Mr. Smith, with his usual courtesy, allowed me to have access, and which is in a somewhat worn condition, was found to show faint traces of a similar sculpture.

Pfeiffer makes no mention of this feature, which, in view of the condition of the shell on which he based his diagnosis, is not surprising.

PAPUINA LENTA, Pfr.

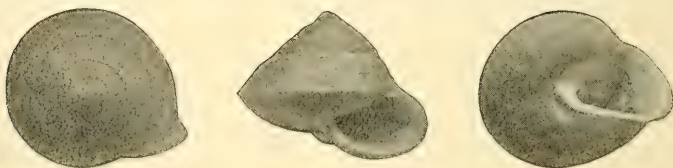
A single dead and worn specimen is not without some doubt referred to this species. In the Cuming Collection occurs a shell—also dead and worn—which, except for the slightly more angulated periphery, is

the exact counterpart of the one now under consideration. The label bears the original inscription, "*H. euchroes*, var.," which was afterwards deleted, and *lenta* substituted. At first I was inclined to consider my shell to be Pfeiffer's *euchroes*, but in spite of the fact that it is of larger size—measuring, diam. maj. 35, min. 28 mm.; alt. 38 mm.—and has, moreover, the spire relatively higher than *lenta*, the balance of evidence appears to me in favour of its being co-specific with the latter species. Pfeiffer, in his original description (Malak. Blätter, 1854, vol. i, p. 57), quotes the figure of *H. pileus*, var., in Conch. Cab., *Helix*, Abth. i, pl. xl, fig. 5, which also has a higher spire, a circumstance adding further weight to my conclusion.

The exact habitat of this species has hitherto remained unknown, the Moluccas having been doubtfully indicated as the original locality (Pfeiffer, Mon. Helic. Viv., vol. iv, p. 257).

PAPUINA RHODOCHILA, n.sp. Figs. 1-3.

Shell sub-covered perforate, trochoidal, ochraceous brown, becoming paler behind the peristome, especially on the base, ornamented with a very narrow dark-brown supra-peripheral band visible on the last three whorls, finely striated, almost ribbed near the mouth, and showing traces of excessively fine spirals above, very minutely and closely granulated on the earlier whorls, the granules becoming sparser and a little coarser on the later whorls, while on the base they are elongated in the direction of the lines of growth and disposed in concentric rows. Spire conical, apex prominent, suture shallow, linear. Whorls $5\frac{3}{4}$, the nepionic convex, the later ones almost flat, except the last, which becomes slightly convex and dilated towards the mouth, is convex below, becoming tumid towards the mouth near the periphery, slightly and slowly descending in front, with an acute



keel slightly pinched on the upper side, and slightly exerted as far as the second whorl. Aperture obovate, a little oblique, margins distant, united by a slight callus on the parietal wall; peristome rosy, a little thickened, expanded and reflexed, upper margin arched, receding, outer rounded, basal slightly curved, columellar strongly reflexed, ascending obliquely forward, dilated and partly covering the narrow umbilicus. Diam. maj. 25, min. 20.5 mm.; alt. 18.5 mm.

Type in my collection.

Represented by a single specimen. No nearly related species from New Guinea is known, but in shape it somewhat resembles the variety *pyramidata* of *P. pileolus*, Mts., from Batchian; that species, however, while being also minutely granulated, possesses several well-marked differentiating characters, and is always more or less ornamented with whitish opaque flammulations on a dark-brown ground.

PAPUINA HEDLEYI, Smith.

Mr. Smith has already mentioned (Ann. Mag. Nat. Hist., 1897, ser. VI, vol. XX, p. 414) that this species is rather variable in colour, and this observation is amply borne out by the series now obtained, the specimens ranging from pale ochraceous to buff and dark, almost blackish, brown, some of the paler shells having a pale base and pinkish peristome, while others have a pale base with dark-brown, narrowly margined peristome, and another has the base blackish brown and a corresponding dark, broadly margined peristome. All dark specimens, however, are characterized by a dark base.

In every case the columella has a more or less prominent whitish thickening which in some specimens bears a tooth or tubercle. All are encircled with numerous narrow, opaque-white, spiral bands, which on the earlier whorls are continuous, but lower down become interrupted by the oblique lines of growth, and disappear on the penultimate or last whorl, but in one instance reaching right up to the peristome, faint traces being also observable on the base in some. The narrow band bordering the keel on both sides also varies from opaque pale ochraceous to yellow in the paler shells, and dark orange in the darker specimens. The species has hitherto been only recorded from South-West New Guinea.

PAPUINA BEAUFORTI, Bavay.

Helix (Papuina) Beauforti, Bavay, Nova Guinea, 1908, vol. v, Zoologie, p. 280, pl. xiv, fig. 8.

As already observed by Mons. Bavay, this species is allied to *euconus*, Müll., but it has a broader base, more convex whorls, and a concave spire, while the spirals on the last whorl and the base (to which, by the way, no reference is made) are much finer and closer. Möllendorff placed his species in *Satsuma* [= *Ganesella*], but, although both this and the new species lack the wrinkled sculpture peculiar to most species of *Papuina*, they possess some features in common with the group of *P. Hedleyi*—which is, moreover, also devoid of wrinkles—i.e. the peculiar manner in which the columellar margin of the peristome covers the narrow perforation of the umbilicus, leaving only a very narrow oblique slit, and the extension of the parietal callus beyond the umbilical region. The close, minute spirals, the pyramidal form, and the appearance of the nepionic whorls still further connect them with this group, and these considerations appear to me to warrant their inclusion in *Papuina*. One specimen was collected.

PAPUINA KAPAURENSIS, Smith.

Ann. Mag. Nat. Hist., 1897, ser. VI, vol. XX, p. 412, pl. ix, figs. 11, 12.

Three specimens, one more elevated in the spire and with wider, less covered umbilicus than the type, and without peripheral band. Diam. maj. 40.5, min. 32 mm.; alt. 26 mm.

Mr. Smith, in describing this species, ventures the opinion that it is perhaps only a variety of *P. lituus* or *P. labium*. It appears to me, however, to be quite entitled to specific rank, being more conical in

shape than either of its allies, differing further in the more flattened whorls, while from another allied form—*P. pseudolabium*—it can easily be distinguished by its more depressed spire. The aperture, also, is more dilated laterally, and the peristome more expanded.

PAPUINA MOLESTA, Smith.

Proc. Malac. Soc., 1897, vol. ii, p. 289, pl. xvii, figs. 10, 11.

A single specimen.

PAPUINA AURORA, Pfr.

A single specimen, with a repaired fracture on the last whorl, was collected. It shows traces here and there of excessively minute granules, more noticeable on the base. This feature is not mentioned by Pfeiffer or any subsequent observer.

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To Balance from last year	10	10	0	By Transferred to Current Account	3	3	0
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We have this day examined the accounts of the Treasurer of the Malacological Society of London, and we find the above statement to be correct.

p.p., JOHN H. PONSONBY, Hon. Treasurer.
R. H. BURNE.

January 25, 1910.

HENRY WOODWARD }
R. BULLEN NEWTON } Auditors.

ANNUAL GENERAL MEETING.

FRIDAY, 11TH FEBRUARY, 1910.

B. B. WOODWARD, F.L.S., President, in the Chair.

Mr. H. C. Fulton and Mr. A. S. Kennard were appointed scrutineers.

The following report was read :—

“Your Council, in presenting their seventeenth Annual Report, are once more in a position to record a year of useful work.

“During that period four new members have been elected. By death we have lost one member, Miss Linter; three more have resigned, and the names of five have been removed from the list according to Rule X.

“The membership of the Society on December 31st, 1909, stood as follows :—

Ordinary members	72
Corresponding members	81
Total	153

“The financial condition of the Society remains substantially the same as last year, but in order not to hamper the work of publication it has been thought advisable to cease for the present the transfer to a special fund of the entrance and composition fees, and to re-transfer to the current account a small proportion of the special fund created last year. The current account, therefore, shows a balance of £1 5s. 11d., while there is also a balance of £7 7s. standing to the credit of the special composition fund. Furthermore, the Society still holds the sum of £50 invested in Metropolitan 2½ per cent. stock.

“During the past year three parts of the ‘Proceedings’ have been issued as usual. They form the last half of Vol. VIII, and consist of 200 pages of text, 8 plates, and 39 text-figures.

“The Society is indebted to the following gentlemen who have kindly contributed towards the cost of the illustrations, or have furnished drawings or photographs for reproduction: Rev. E. W. Bowell, F. G. Bridgman, Lieut.-Col. H. H. Godwin-Austen, G. K. Gude, F. W. Harmer, J. W. Jackson, A. J. Jukes-Browne, H. B. Preston, H. O. N. Shaw, E. A. Smith, G. B. Sowerby, H. Suter, E. R. Sykes, and B. B. Woodward. Without such assistance it would have been impossible to illustrate the ‘Proceedings’ so fully.

“Further, the thanks of the Society are especially due to the Council of the Linnean Society, through whose kindness it has been permitted, as in former years, to hold its meetings in Burlington House.”

On the motion of Mr. A. S. Kennard, seconded by Mr. H. B. Preston, the above was adopted as the Annual Report of the Society.

The following were elected as Officers and Council for the year 1910.

President.—R. Bullen Newton, F.G.S.

Vice-Presidents.—Col. R. H. Beddome, F.L.S.; Rev. R. Ashington Bullen, B.A., F.L.S.; R. H. Burne, M.A., F.Z.S.; B. B. Woodward, F.L.S.

Treasurer.—J. H. Ponsonby, F.Z.S., 15 Chesham Place, London, S.W.
Secretary.—G. K. Gude, F.Z.S., 45 West Hill Road, Wandsworth, London, S.W.

Editor.—E. A. Smith, I.S.O., Natural History Museum, Cromwell Road, London, S.W.

Other Members of Council.—W. E. Collinge, M.Sc.; G. C. Crick, F.G.S.; S. Pace, F.Z.S.; H. B. Preston, F.Z.S.; W. G. Ridewood, D.Sc., F.L.S.; E. R. Sykes, B.A., F.Z.S.

On the motion of Mr. S. Pace, seconded by Mr. H. C. Fulton, a vote of thanks was passed to the Retiring Officers and Members of the Council, and to the Auditors and Scrutineers.

ORDINARY MEETING.

FRIDAY, 11TH FEBRUARY, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The following communications were read :—

1. "On *Unio*, *Margaritana*, *Pseudanodonta*, and their occurrence in the Thames Valley." By Fritz Haas.
2. "Description of *Vivipara fragilis*, n.sp., from Dutch New Guinea." By H. B. Preston, F.Z.S.
3. "On an undescribed *Anodonta* from the English Wealden Formation, with remarks on the other Unionidæ of the same period." By R. Bullen Newton, F.G.S.

ORDINARY MEETING.

FRIDAY, 11TH MARCH, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The following communications were read :—

1. "Notes on (1) Pleistocene, (2) Holocene, (3) Recent non-marine Shells from Mallorca; (4) Marine Shells associated with the Holocene deposits; (5) Marine Shells from Alcudia, Mallorca; (6) Non-marine Shells from Manresa, Cataluna." By Rev. R. Ashington Bullen, B.A., F.L.S.
2. "On the occurrence in England of *Valvata macrostoma*, Steenbuch." By A. S. Kennard, F.G.S., and A. W. Stelfox.
3. "Description of a new species of *Helicodonta*, from Spain." By G. K. Gude, F.Z.S.

The President exhibited a piece of limestone formation of Quaternary age from Madeira containing *Geomitra* (*Plebecula*) *Bowdichiana*.

Mr. G. C. Crick, F.G.S., exhibited a *Belemnites* showing the protoconch.

ORDINARY MEETING.

FRIDAY, 8TH APRIL, 1910.

B. B. WOODWARD, F.L.S., Vice-President, in the Chair.

Mr. H. J. Fleure was elected a member of the Society.

The following communications were read:—

1. "The Distribution of *Margaritana margaritifera* (Linn.) in North America." By Bryant Walker.
 2. "Description of a new species of *Voluta*, from West Australia." By Dr. J. C. Cox.
 3. "Description of a new species of *Latirus*." By J. Cosmo Melvill, M.A., D.Sc.
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OBITUARY NOTICES.

It is with much regret that we have to record the death of Miss J. E. LINTER, who had been a member of the Society since the year 1895.

Of a retiring disposition Miss Linter did not attend the meetings of the Society, and consequently was not known personally to many of the members. She was, however, an enthusiastic collector, and her cabinets contained very many rare and interesting species, more especially of land shells. Many of these came from the collections made in India by W. Theobald and Colonel Skinner.

It is understood that her collection has been bequeathed to the Devon and Exeter Museum on condition that it would be accessible to the public.

Miss Linter was born at Teignmouth in the year 1844, and her death occurred at her residence, Saville House, Twickenham, on August 30th, 1909.

E. A. SMITH.

We also have to record, with deep regret, the death of the Rev. GEORGE FERRIS WHIDBORNE, M.A., F.G.S., etc., which took place on the 14th of February last at the age of 64. Mr. Whidborne was a member of this Society for upwards of sixteen years, but rarely attended its meetings and was not a contributor to the 'Proceedings'. On palæontological subjects, however, he accomplished considerable work, especially in connexion with the British Inferior Oolite Pelecypoda, and the various groups of mollusca found in the Devonian formation of the South of England. The magnitude of his Devonian Memoir, published by the Palæontographical Society, may be better understood when it is stated that the parts devoted to the Cephalopoda, Gastropoda, and Pelecypoda comprise more than fifty quarto plates and upwards of five hundred pages of descriptive text. As a man of considerable wealth, he was able to command any number of plates for illustrating his monographs, and these have largely added to the importance and value of his palæontological writings. The following are his principal memoirs:—

1. "On some Fossils of the Inferior Oolite."—*Lamellibranchiata*: Rep. Brit. Assoc., 1882, p. 534 (1883).
2. "Notes on some Fossils, chiefly Mollusca, from the Inferior Oolite": *Quart. Journ. Geol. Soc.*, 1883, vol. xxxix, pls. xv–xix, pp. 487–540.
3. "On some Devonian Cephalopods and Gasteropods": Rep. Brit. Assoc., 1888, pp. 680–1 (1889).
4. "On some Fossils of the Limestones of South Devon": *ibid.*, pp. 681–2.
5. "Monograph of the Devonian Fauna of the South of England": Palæontographical Society, 1890–7. Cephalopoda, comprising 13 pls. and 111 pp. of text; Gastropoda, 19 pls. and 215 pp.; Pelecypoda, 19 pls. and 162 pp.
6. "Devonian Fossils from Devonshire": *Geol. Mag.*, 1901, pls. xvii, xviii, pp. 529–40.

R. B. NEWTON.

NOTES ON POLYPLACOPHORA, CHIEFLY AUSTRALASIAN. (PART I.)

By TOM IREDALE.

Read 14th January, 1910.

SINCE the publication of Pilsbry's Monograph in the *Manual of Conchology* much work has been done in the study of Australasian Polyplacophora. Pilsbry himself described many species from material supplied by Dr. Cox and Mr. Bednall: he wrote up the Port Jackson Chiton fauna, and reviewed the Australian Acanthochitidæ (Proc. Acad. Nat. Sci. Philad., 1894, pp. 69 et seq.). A collection of Chitons from Port Phillip, Victoria, was, very shortly afterwards, worked through by Mr. E. R. Sykes, the only recent work on Australian Chitons published in England. In that paper (Proc. Malac. Soc., 1894, vol. i, pp. 84 et seq.) much was done in clearing up obscure points through Mr. Sykes having access to the British Museum, where the types of early and indefinitely described Australian species are preserved. A splendid account of South Australian Chitons followed from the pen of Mr. W. T. Bednall (Proc. Malac. Soc., 1897, vol. ii, pp. 139 et seq.), whilst the Neozelanic forms were listed by Mr. Suter in the same periodical (1897, vol. ii, pp. 183 et seq.). Since then the work has been assiduously carried out all over Australasia with very gratifying results. As well as Mr. Bednall and Mr. Matthews, Messrs. Torr, Ashby, and Maughan have contributed to the South Australian list; Messrs. Gabriel and Gatliff have been searching Victorian waters; Mr. A. F. Basset Hull has been working Port Jackson, New South Wales, and in addition has investigated Norfolk and Lord Howe Islands. As regards Queensland, Mr. Hedley has collected on the Great Barrier Reef, whilst Dr. Torr and I have made small but interesting collections at Port Curtis and Caloundra. In New Zealand much collecting has been done by Miss Mestayer, Captain Bollons, Messrs. Murdoch, Webster, Suter, and myself. In addition I have obtained interesting species from the Kermadec Group. In spite of all this work there were species admitted to the Australasian fauna only represented by unique examples in the British Museum, as for instance, *Spongiochiton productus*, Pilsbry, *Plaxiphora obtecta*, Pils., *Plaxiphora egregia*, H. Ad., *Acanthochites carinatus*, Ad. and Ang., and *Chorioplax Grayi*, Ad. & Ang. In addition, species described by Blainville, Quoy & Gaimard, Filhol, and Rochebrune had not been recognized, and the types, if in existence, needed examination. Upon inquiring of Dr. L. Germain, of Paris, he courteously proffered to oblige me with such as were in existence, but pointed out that Dr. Thiele had just recently studied them. I immediately wrote to Dr. Thiele, who graciously forwarded me a copy of his work which he had just completed. Though unable to agree with all his conclusions, this work must be regarded as the most important contribution to the literature of the Polyplacophora since the publication of Pilsbry's monograph. Having worked over the same ground as myself, I find many of my conclusions anticipated, such as the transference of

Wahlbergi, Krauss, from *Plaxiphora* to *Onithochiton*, separation of *Plaxiphora Fremblyi*, Brod., from *setiger*, King., publication of *Plaxiphora Pateliana*, Thiele, *Onithochiton Scholvienei*, Thiele, etc. As I had concerned myself principally with specific determinations, I am enabled to add to some of his notes and confirm others, whilst with very few I disagree. This paper is a medley of notes covering all the genera of the Polyplacophora, and will be succeeded by further contributions on the same lines. I have just received a paper on Port Jackson Chitons by my good friends Messrs. Hedley and Hull, and find they have notes on two of the species here treated.

I wish to thank Mr. E. R. Sykes for the pleasure of examining well-authenticated Australian *Plaxiphora*.

ISCHNOCHITON GRYEI (Filhol).

Tonicia Gryei, Filhol, Comptes Rendus, 1880, vol. xci, p. 1095.

Lepidopleurus melanterus, Rochebrune, Bull. Soc. Philom. Paris, 1883-4, p. 37.

Ischnochiton Parkeri, Suter, Proc. Malac. Soc., 1897, vol. ii, p. 186, figs. in text.

I. fulvus, Suter, Journ. Malac., 1905, vol. xii, p. 66, pl. ix, figs. 5-10; Iredale, Trans. N. Zeal. Inst., 1907 (1908), vol. xl, p. 373.

In 1880 Filhol described (?) a shell which he had collected at Campbell Island under the name *Tonicia Gryei*. Later Rochebrune described (?) a shell which Filhol had collected at Campbell Island under the name *Lepidopleurus melanterus*. Both descriptions were inadequate, and in each case the generic disposition inaccurate.

I received from the Paris Museum a bottle containing a large number of shells with Rochebrune's label attached to them. The whereabouts of Filhol's shells was unknown. As these shells answer Filhol's description, such as it is, I consider they are the original lot, and in justice to Filhol as the collector as well as describer, they should bear his prior name.

Thiele, having examined these same shells, has declared the identity of *Parkeri*, Suter, and *fulvus*, Suter, with them (Zool. Chun, Heft. lvi, p. 111). Previous to the receipt of Thiele's work and the Paris shells I had found myself unable to separate *Parkeri*, Suter, and *fulvus*, Suter.

ISCHNOCHITON SULCATUS (Q. & G.).

Chiton sulcatus, Q. & G., Voy. Astrolabe, Zool., 1834, vol. iii, p. 385, pl. lxxv, figs. 31-6.

C. decussatus, Reeve, Conch. Icon., 1847, pl. xviii, fig. 107.

C. castus, Reeve, op. cit., pl. xxii, fig. 145.

Lepidopleurus speciosus, Ad. & Ang., P.Z.S., 1864, p. 192; 1865, p. 187.

Gymnoplax Urvillei, Rochebrune, Bull. Soc. Philom. Paris, 1880-1, p. 121.

Ischnochiton sulcatus, Q. & G.: Pilsbry, Man. Conch., 1893, ser. i, vol. xiv, p. 138, pl. xxxviii, figs. 24-6.

I. decussatus, Reeve: Bednall, Proc. Malac. Soc., 1897, vol. ii, p. 146.

The whereabouts of the type of Quoy & Gaimard's species was unknown, but examination of the type of Rochebrune's *Urvillei* showed that that name was founded upon it. The shell was easily recognized from Quoy's beautiful figures, though no one would have guessed it from Rochebrune's description. Apparently the label had been lost, and without referring to the "Voy. de l'Astrolabe" Rochebrune renamed it, hiding its identity under a careless diagnosis!

Thiele has already pointed out that *Urvillei*, Roche. = *decussatus*, Reeve (Zool. Chun, 1909, Heft lvi, p. 8). Examination of the types of the species denoted as synonymous absolutely confirms this, but strangely the species from the Swan River named *castus*, Cpr. MS., and whose description is given in the Man. Conch., vol. xiv, p. 94, is quite distinct, and is either a good variety or species according to whether it is the only form on the Westralian coast.

PLAXIPHORA CÆLATA (Reeve).

Chiton cælatus, Rve., Conch. Icon., 1847, pl. xvii, fig. 101.

C. (Plaxiphora) terminalis, Smith, Voy. Erebus and Terror, Moll., 1874, p. 4, pl. i, fig. 13.

This synonymy is not novel, having been published by Suter (Proc. Malac. Soc., 1897, vol. ii, p. 189), and I had not intended to remark upon it. But Thiele has published a new species, *Schauinslandi* (Zool. Chun, 1909, Heft lvi, p. 28, pl. iii, figs. 41-3), which has induced me to record these details of the types. The tablet which bears Reeve's name has on it four specimens, the first one of which appears to be the shell from which Reeve's figure was prepared.

The tablet which contains Smith's typical specimens has six shells of varying sizes. A shell of the same size as Reeve's type was critically compared with it and found inseparable. The largest shell, which to me was certainly conspecific, showed finer sculpture and differences consistent with increased age and growth. When Smith separated his *terminalis* he was using shells marked *cælata*, Rve. (= *cuprea*, Cpr.), for comparison. These, as I presently show, were *biramosa*, Q. & G. Thiele's figures and description of his *Schauinslandi* agree perfectly with this large *terminalis*, and if it should be found later necessary to separate it, then the prior *terminalis* must be used, so that in any case *Schauinslandi* is a synonym.

PLAXIPHORA OBTECTA, Pilsbry.

In the Nachr. deutsch. malak. Ges., 1909, vol. xli, p. 72, Suter, correcting Wissel's identifications (!) (Zool. Jahrb. Syst., 1904, xx, pp. 591-662) of New Zealand Chitons, has accepted the identity of the later-named *P. Suteri*, Pils., from which view he had previously dissented. He still retains in the synonymy of this species, however, *Mopalia ciliata*, Sow., of Hutton's Manual, p. 116. In that place Hutton quotes Reeve's figure, and copies Reeve's description. Reeve figured a shell like *cælata*, and states New Zealand (Earl). No one could confuse Reeve's figure with the shell

under notice, and I would transfer *Mopalia ciliata*, Sow., of Hutton's Manual, p. 116 (not of Sowerby), to *cælata*, Reeve.

When Pilsbry took up Carpenter's description of *Guildingia oblecta* he did not fully grasp the idea of the shell, otherwise he would not have written (Man. Conch., ser. i, vol. xiv, pp. 329-30)—“This section, like *Fannettia* in the genus *Tonicia*, rests upon a character of very little taxonomic value.” “It is, however, simply an exaggeration of *P. terminalis*.” The species is quite unlike *terminalis* from whatever point of view it is examined, and stands quite aloof from all other Australasian *Plaxiphora* in being quite smooth.

PLAXIPHORA EGREGIA (H. Adams).

Frembleya egregia, H. Ad., P.Z.S., 1866, p. 445, pl. xxxviii, fig. 9.

Acanthochætes ovatus, Hutton, T.N.Z.I., 1872, vol. iv, p. 182; 1880, Man. N.Z. Moll., p. 177.

Plaxiphora egregia, H. Ad.: Pilsbry, 1893, Man. Conch., ser. i, vol. xiv, p. 331, pl. lxxv, figs. 81, 82.

P. ovata, Hutton: Pilsbry, loc. cit., p. 332, pl. liv, figs. 34-40; Suter, Proc. Malac. Soc., 1897, vol. ii, p. 192; Iredale, T.N.Z.I., 1907, vol. xl, p. 375, pl. xxxi, fig. 1 (abnormal specimen) (1908).

Fremblya ovata, Hutton: Thiele, Zool. Chun, 1909, Heft lvi, p. 29, pl. iii, figs. 50-2.

Fremblya egregia, H. Adams, described and figured in 1866 from “unknown habitat”, appears to have received very little attention since. In 1872 Hutton described a New Zealand shell as *Acanthochætes ovatus*.

In 1893 Pilsbry included both under *Plaxiphora*, reducing *Fremblya* to sectional rank. To *egregia* he allotted an Australian habitat on Carpenter's MSS. “collected by Dieffenbach, Newcastle, Australia”, and as a synonym gave *Streptochiton tortuosus*, Cpr. MSS. olim. He also gave Carpenter's manuscript detailed description of the type. In the British Museum are the type tablet and three other tablets, one marked “Newcastle, Australia, Dieffenbach”, and the two others from New Zealand. All these last three are labelled *S. tortuosus*, Cpr., in Carpenter's handwriting.

As Dieffenbach collected largely in New Zealand, I consider it feasible to suppose that an erroneous label has been attached to the shells, as otherwise it is unknown from Australia, and I do not consider it should be included in Australian lists.

There can be no doubt that all the specimens are conspecific, and as *egregia* has priority it must replace the familiar *ovata*.

Thiele has reinstated *Fremblya* as a full genus, but I cannot yet see characters sufficiently strong to cause me to follow him.

PLAXIPHORA BIRAMOSUS (Q. & G.).

Chiton biramosus, Quoy & Gaimard, Voy. Astrolabe, Zool., 1834, vol. iii, p. 378, pl. lxxiv, figs. 12-16.

Tonicia corticata, Hutton, T.N.Z.I., 1872, vol. iv, p. 180.

Plaxiphora biramosus, Q. & G.: Hutton, Man. N.Z. Moll., 1880, p. 116.

P. biramosa, Q. & G.: Pilsbry, Man. Conch., 1892, ser. i, vol. xiv, p. 319, pl. lxviii, figs. 51-4; Suter, Proc. Malac. Soc., 1897, vol. ii, p. 188; Thiele, Zool. Chun, 1909, Heft lvi, p. 26, pl. iii, figs. 37, 38.

Governed by Quoy's figures, which to me showed a smooth shell, and which his description does not contradict, I had identified a smooth *Plaxiphora* as *biramosa*. Having done this, I could not separate from that species Suter's *subatrata*, which seemed synonymous with the prior *Campbelli* of Filhol.

Upon examination of the shells in the British Museum, I found that all the shells I would have referred to *biramosa*, Q. & G., were marked *superba*, Cpr., in agreement with his type. Another shell which I did not know was marked *calata*, Reeve = *cuprea*, Cpr., but it was unlike the type of *calata*, Reeve. I soon made it out to be the shell Suter called *biramosa* in the Proc. Malac. Soc., vol. ii, p. 188, and whose description of a corrugated shell had always puzzled me.

I re-read Quoy's account and noted that he pointed out that the shells he had differed in form externally. The puzzle was now easily unravelled, as, by allowing Quoy to have had both a corrugated and smooth shell, the history reads thus.

Hutton in 1872 had not access to Quoy, and from Deshayes culled his account of *biramosus*. He then introduced his *Tonicia corticata* as a new species. His description of this shell makes it very easy to identify the corrugated shell Suter adopted as *biramosa*. It is true that many years later Hutton thought a much damaged shell, which turned out to be *Acanthopleura granulata*, Gm., was his *corticata*, but the description of the latter species agrees minutely with the corrugated *biramosa*, whilst it disagrees just as completely with *granulata*. In 1880, with access to Quoy, Hutton included *corticata* as a synonym of *biramosa*, and states "Reeve is quite wrong in uniting this species with *C. setiger*, King".

In 1892 Pilsbry, knowing neither the smooth nor corrugated shell, added to Quoy's *biramosa* a smooth shell described in MS. by Carpenter as *superba*. He doubted Hutton's attachment of his *corticata* to *biramosa*, stating "in sculpture it [*corticata*] must resemble *P. terminalis*".

Suter in 1897, calling the corrugated shell *biramosa*, separated *superba* as a valid species, but not knowing it, save from the description, also described *subatrata*, which he noted might be *Campbelli* of Filhol.

With the receipt of Quoy's types to verify these conclusions, which I found to be correct, I also received Filhol's type of *Campbelli*. However, Dr. Thiele's work has anticipated me in this, as he had examined these types, and there found the two shells represented. He has followed Suter in restricting the name *biramosa* to the corrugated shell, and, as it is quite distinctive, no further confusion can possibly ensue.

In all its internal as well as external features it is quite easily separable from the other Australasian *Plaxiphora*. From the

stoutness of the valves and the length of the insertion plates it can be recognized as living well out in the breakers, occupying more exposed situations than the smooth shell *Campbelli*, Filhol, which usually accompanies it on the coasts of New Zealand.

PLAXIPHORA CAMPBELLI, Filhol.

Plaxifora Campbelli, Filhol, Compt. Rend., 1880, vol. xci, p. 1095.

Plaxiphora Campbelli, Filhol: Pilsbry, Man. Conch., 1893, ser. I, vol. xv, p. 107.

P. superba (Pils.): Suter, Proc. Malac. Soc., 1897, vol. ii, p. 188.

P. subatrata, Pils.: Suter, loc. cit., p. 190.

Under *Plaxiphora biramosa*, Q. & G., Thiele (Zool. Chun, 1909, Heft lvi, p. 27) also works out this synonymy, and gives figures of the fifth and eighth valves of this species (pl. iii, figs. 39, 40). This is the only species of *Plaxiphora* I have seen from the Auckland and Campbell Islands, where it appears to be very abundant. It extends all over New Zealand, where, however, it is a rare shell.

PLAXIPHORA FREMBLYI (Broderip).

Chiton Frembleii, Brod., P.Z.S., 1832, p. 28.

C. setiger, var. *Frembliei*, Brod.: Sowerby, Conch. Ill., 1833, p. 7, fig. 4.

C. setiger, var. β , Reeve, Conch. Icon., 1847, pl. ix, fig. 48b.

Plaxiphora setiger, var. *Fremblyi*, Brod.: Pilsbry, Man. Conch., 1893, vol. xiv, p. 318.

Chiton Fremblyi, Brod.: Clessin, Conch. Cab., 1904, Heft xvii, p. 117, pl. xli, fig. 6.

Plaxiphora Fremblyi, Brod.: Thiele, Zool. Chun, 1909, Heft lvi, p. 23, pl. iii, figs. 12-14.

This species has been, owing to its rarity, deprived of its due until this year. Dr. Thiele anticipated me in restoring it to the place it deserves, and has given figures of the fifth and eighth valves of one of the type lot. Unfortunately the figure does not show the sculpture, and it is quoted as *P. setiger*, var. *Frembliei*, Brod., by Dall (Proc. U.S. Nat. Mus., 1909, vol. xxxvii, p. 246) immediately after he had received Thiele's paper.

It is quite unlike '*setiger*', being a South American representative of the Australian corrugated *Plaxiphora*, having exactly the same coloration as is there commonly met with.

The girdle is very wide, thin, horny, and sparsely scattered over with hairs not at all like the girdle of '*setiger*'. The head-valve is eight-ribbed and *concentrically closely sulcate*.

In the median valves the lateral areas are defined by an indistinct raised rib, and are *closely longitudinally wrinkly sulcate*, the central areas are smooth, and the sides of the pleura are *zigzagly sculptured* from the lateral rib. This sculpture is well marked, and nothing like it is shown in the many specimens of '*setiger*' I have examined. Moreover, the valves are rounded, whereas every '*setiger*' is very distinctly keeled.

Pilsbry believed *C. Hahni*, Roche., to be identical, and gives reproductions of Rochebrune's figures under this species. I have seen the type of Rochebrune's species, and find that it is simply a '*setiger*'.

PLAXIPHORA CARMICHAELIS (Wood).

Chiton Carmichaelis, Wood, Supp. Index Test., 1828, pl. i, fig. 10;

Gray, Spicil. Zool., July, 1828, pl. i, p. 6.

C. setiger, King, Zool. Journ., 1831, vol. v, p. 338.

The type tablet of *Carmichaelis*, Gray, bore two specimens, both about the same size, one straight and one curled. The latter was the one figured by Wood, whose name has priority. Sykes in his account of the Polyplacophora of South Africa pointed out that though Pilsbry doubted the accuracy of Gray's attachment of *setiger*, King, to *Carmichaelis* he had examined the specimens, and concluded that *setiger* must give way to *Carmichaelis*, which must be crossed off the South African list. There are many specimens of *setiger*, King, from King's collection in the British Museum, varying in size from that of *Carmichaelis* to specimens 40 mm. in length, and upon dissecting one of the small specimens for comparison with one of the types of *Carmichaelis* no points of difference could be detected. The external characters were absolutely identical. Hence the name *setiger*, King, must give way to *Carmichaelis*, Wood.

From South America and the Falkland Islands two very distinctly coloured shells are received, and I believe they must be separate species. I hope to refer to this later, but in the meantime the above names are absolutely synonymous through examination of the types.

Fig. 79 of pl. lxx in the Manual of Conchology, vol. xiv, was drawn from one of the type lot of King's shells.

PLAXIPHORA IN AUSTRALIA.

In the Manual of Conchology Pilsbry included *petholata*, Sowerby, to which he attached Adams & Angas's *conspersa*, as a variety upon Carpenter's MS., and *glauca*, Quoy & Gaimard, as Australian, with a new species of Carpenter, *excurvata*, as perhaps Australian members of the genus *Plaxiphora*. Neither *conspersa*, Ad. & Ang., nor *glauca*, Q. & G., had he seen. Later, dealing with Port Jackson Chitons, he only recorded *petholata*, Sow., from that locality. Sykes only allowed *petholata*, Sow., when he catalogued the Victorian Chitons. Bednall from South Australia recorded three species—*petholata*, Sow., *conspersa*, Ad. & Ang., and *glauca*, Q. & G.

By Australian students these were easily separated by superficial characters, *petholata*, Sow., being the common variable corrugated species, *conspersa*, Ad. & Ang., being a very distinctive small shell, and *glauca*, Q. & G., being a big smoothish shell. Only so-called *petholata*, Sow., was collected at Port Jackson by Mr. A. F. Basset Hull, and to him there appeared to be two species confused under that name. He asked me to look into the matter and find out which was Sowerby's species.

The types of Sowerby's *petholata*, as also the variety *porphyrius*, which has never been recognized, are, however, non-existent. Upon

examining the shells in the British Museum from various Australian localities I obtained nothing but contradictions. Awaiting news of the type of *glauca*, Quoy & Gaimard, I dissected a typical smooth shell from South Australia, determined as *glauca*, Q. & G., by Mr. W. T. Bednall. The tail-valve separated it at once from the Port Jackson corrugated *petholata*, Sow. However, Tasmanian shells from the Cuming Collection, labelled *petholata*, Sow., and recorded in the Man. Conch. under that name, were identical with the South Australian *glauca*.

Adams & Angas's type of *consersa* was next dissected, and differed only slightly from the Port Jackson *petholata* in internal characters, though widely so in colour. Shells sent from Port Jackson as *consersa* Ad. & Ang., were simply *petholata* of brighter coloration. The shells sent from South Australia by Bednall were, however, quite different from Adams & Angas's type, approaching *egregia*, H. Ad., more than any other Australian *Plaxiphora*.

Shells from Queensland turned out to be internally identical with the South Australian *glauca*, though externally faintly corrugated.

Victorian specimens, though of dark coloration, agreed better with *consersa*, Ad. & Ang., than with *petholata*, Sow., from Port Jackson.

The two species indicated by Mr. Basset Hull appeared to be easily separable by means of the sculpture, and the second species I have not yet seen from any other locality than Port Jackson.

I had thus arrived at four Australian species when I received Dr. Thiele's "Revision des Systems der Chitonon", which caused me to review my specimens and results. Working upon the characters of the tail-valves similarly to myself, he has separated five species without considering either Adams & Angas's *consersa* or Bednall's determination of that species. The work is most beautifully illustrated with splendidly drawn figures of the fifth and eighth valves of his species, which make their identification simple. However, through lack of specimens, he has laid too much stress upon the value of the shape of the valves. The shape varies quite considerably with age and environment, specimens living exposed to heavy breakers having much longer insertion plates, and being less elevated than those living a more secluded life. Young shells are also more strongly sculptured than older ones, and the shape of their valves shows differently. The big smooth *petholata*, commonly called *glauca*, Q. & G., has the young well sculptured.

Having examined the types of *costatus*, Blain., and *albidus*, Blain., these names are fixed by Thiele as applicable to the two common Australian *Plaxiphora*. He makes *petholata*, Sow., synonymous with the former, but the latter seems nearest to the commonly accepted *petholata*, Sow. The rejection of this well-known name, though repugnant, appears unavoidable, especially as the type is non-existent, and its features are obscure. Blainville's *costatus* is easily recognizable as the species I have above noted as *glauca*, Q. & G. The tail-valve seems distinctive. Blainville's *albidus* covers the majority of the shells commonly known in Australia as *petholata*, Sow., and is the shell Adams & Angas called *consersa*.

Tasmanian specimens of *glauca*, Q. & G., differed slightly, and these he christens *Tasmanica* on account of the prior *glaucus*, Gray.

Dissecting shells received from Mr. Bednall under the name *glauca*, Q. & G., he makes them differ and calls them *Bednalli*. His figures did not appear to show sufficient characters to enable me to judge of their specific value, so I dissected a further number of Tasmanian and South Australian shells.

South Australian *glauca* were easily *costata*, but South Australian *petholata* varied, some being *costata*, others *albida*, and others midway between *albida* and *Tasmanica*.

A number of Tasmanian shells furnished still more interesting results. One was a beautiful typical *Bednalli*, a second was nearer *Tasmanica*, whilst a bigger specimen, though undoubtedly the same species, had much longer insertion plates, and of course the shape of the valves differed. Some were corrugated, others smoothish, one South Australian example, though almost typically *albidus*, being very smooth, yet young. Young shells, wherever collected, differed among themselves, but not constantly, and it seemed useless to attempt to allocate them.

I am therefore compelled to advise the rejection of *Tasmanica* (= *Bednalli*), and cannot even advise its use as a varietal designation. Further study must be carried out in the field, and it is just possible that the habits of the animals may give clues which will enable the fixation of differential characters. From my studies I feel sure that no such features have yet been grasped.

Thiele's fifth species is the second Port Jackson species I have above indicated. He has named it *Peteliana*, and by means of the sculpture and form it seems well characterized. From the depressed form and long insertion plates it lives on more exposed situations than its companion. As the shells from Australia labelled *petholata* and *glauca* have resulted in such mixed results, no correct synonymy of the new names can be drawn up. Suter (Journ. Malac., 1905, vol. xii, p. 66) has recorded *glauca*, Q. & G., from the Chatham Islands. It will be interesting to know to which species, if either, the Chatham Island shell has to be referred. Thiele has introduced a new species *Schauinslandi* from that locality, but that is clearly only a fine *cælata*, Reeve.

PLAXIPHORA COSTATA (Blainville).

Chiton costatus, Blain., Dict. Sci. Nat., 1825, vol. xxxvi, p. 548;

Pilsbry, Man. Conch., 1893, vol. xv, p. 105.

Plaxiphora costata, Blain.: Thiele, Zool. Chun, 1909, Heft lvi, p. 24, pl. iii, figs. 20, 21.

I have seen this shell from Queensland, Tasmania, and South Australia.

PLAXIPHORA ALBIDA (Blainville).

Chiton albidus, Blain., Dict. Sci. Nat., 1825, vol. xxxvi, p. 547;

Pilsbry, Man. Conch., 1893, vol. xv, p. 105.

C. glaucus, Q. & G., Voy. Astrolabe, Zool., 1834, vol. iii, p. 376, pl. lxxiv, figs. 7-11.

? *C. petholatus*, Sow., Mag. Nat. Hist., n.s., 1840, vol. iv, p. 289;
var. *porphyrius*, Sow., loc. cit.

Chætopleura conspersa, Ad. & Ang., P.Z.S., 1864, p. 193; P.Z.S.,
1865, p. 187.

Plaxiphora albida, Blain.: Thiele, Zool. Chun, 1909, Heft lvi, p. 24,
pl. iii, figs. 22, 23.

P. Tasmanica, Blain.: Thiele, loc. cit., p. 25, pl. iii, figs. 24-6.

P. Bednalli, Blain.: Thiele, loc. cit., p. 25, pl. iii, figs. 27-30.

Variously alluded to as *petholata*, Sow., and *glauca*, Q. & G. I have seen this species from New South Wales, Victoria, South Australia, and Tasmania.

PLAXIPHORA PÆTELIANA, Thiele.

Plaxiphora Pæteliana, Thiele, Zool. Chun, 1909, Heft lvi, p. 26, pl. iii,
figs. 34-6.

This species I have only as yet seen from Port Jackson, New South Wales.

PLAXIPHORA MATTHEWSI, n.sp.

Plaxiphora conspersa (non Ad. & Ang.), Bednall, Proc. Malac. Soc.,
1897, vol. ii, p. 154.

Shell small, keeled, elevated, elongate oval, side slopes straight. The shells are usually covered with algæ, but the ground colour can be discerned as yellowish white, with longitudinal brownish markings. The anterior valve is eight-ribbed; the ribs are strong and crenulate the margin of the tegmentum. It is broad, very elevated, with the apex acute, and slightly recurved. The insertion plate is very short, thick, cut into by eight evenly spaced grooved teeth, thickened at the edges of the slits, convex internally. Externally, between the ribs, angularly corrugated. The median valves have the lateral areas indicated by a strong elevated rib which is nodose in young specimens. The posterior margin of the median valves is raised by a similar strong rib; between these two the slight sculpture is wrinkle V-shaped. The pleural areas are corrugately sculptured towards the sides, becoming smooth on the median areas. The sutural laminae broad, short, with the sinus narrow; highest about midway between sinus and edge, but in the fifth valve scarcely appreciable. The insertion plates are as in anterior valve, very short, thick, one slit agreeing with the lateral rib. The posterior valve is broad, the tegmentum narrow from sinus to mucro, which is terminal, acute, and elevated. The lateral area consists of a crescentic raised rib, in front of which is a concave portion, with an anterior elevation. The insertion plate is represented by a thick semicircular, slightly sinuated callus. The sutural laminae are broad, short, and almost straight. The internal coloration is white with the faintest bluish tinge.

In the dried specimens I have, the girdle is leathery, with hairs disposed in bundles at the sutures. I anticipate this description of the girdle will need emendation upon examination of fresh shells. It shows a posterior sinuation. Length of type, 22 mm.; breadth, 13 mm.

Hab.—South Australia.

Type in British Museum.

From the very short insertion plates it was easily deduced that it lived in sheltered places. Bednall, at the above reference, writes—“Occurs in company with the *Ischnochitons* under blocks of stone in comparatively smooth water,” and gives as localities—“North Arm, Port Adelaide on *Pinna* (Bednall): Sultana Bay, Yorke Peninsula, S.A. (Matthews & Bednall).”

This most interesting shell is by the peculiar characters of the tail-valve, which I have endeavoured to denote, nearest *egregia*, H. Ad. That species is the type of Adams' genus *Fremblya*, and I should also so place this shell. Pilsbry reduced this to sectional rank, but Thiele has reinstated it as a full genus, so it will be very interesting to see whether this shell will bear out Thiele's conclusions. I have no spirit specimens. It stands quite apart from the other Australian corrugated *Plaxiphora*.

PLAXIPHORA EXCURVATA, Pilsbry.

Plaxiphora excurvata, Pilsbry, Man. Conch., vol. xiv, p. 327.

This species, described from Carpenter's MSS., is unfigured, and to me quite indeterminable. It is quoted—“This shell has a general external resemblance in size and shape to *P. cuprea*,” but is stated to be 70 mm. long by 39 broad. The largest specimen of *P. cuprea*, so named by Carpenter himself, is only 53 mm. by 34 mm., so that some error has crept in. The angle of divergence would also indicate a much higher shell than is usually met with among Australian *Plaxiphora*.

Until the type is re-examined it seems that this species must be ignored, as the name cannot possibly be allotted to either of the preceding four Australian species.

SPONGIOCHITON PRODUCTUS, Pilsbry.

Spongiochiton productus (Cpr.), Pilsbry, Man. Conch., vol. xiv, p. 26; vol. xv, p. 7.

Acanthochites Carpenteri, Pilsbry, loc. cit., vol. xv, p. 35, pl. i, figs. 14–22.

A shell supposed to be from New Zealand was named in MS. by Carpenter as *Spongiochiton productus*, new genus and new species. Though twice noticed previously in literature, the species was never published until Pilsbry took it up in 1892. With Carpenter's good manuscript description there were no figures.

Later Pilsbry came upon some drawings of a shell made under the direction of Carpenter. These were unnamed, localized as “Port Elizabeth, South Africa”, and as the measurements given differed Pilsbry described them as *Acanthochites Carpenteri*, allotted them to the section *Notoplax*, but recognized their similarity to *productus*, as he wrote—“Compare *Spongiochiton productus*.” This latter is quite unknown to New Zealand students, and the former to South African ones.

I intended to make drawings of *productus* when I recognized that *Carpenteri* was founded on such drawings. Of this there is not the slightest doubt.

As Thiele has just published a species of *Craspedochiton* from Mauritius, which is very closely allied to *productus*, it would seem the South African locality is more likely to be correct.

It will be noted that Pilsbry included the drawings under *Notoplax*.

My examination of the type has induced me to propose that it be relegated to *Craspedochiton*, using that name as a section of *Acanthochites*. My reasons are: the tail-valve of *productus* is essentially the same as that of *violaceus*, Q. & G., the type of *Loboplax*.¹ *Rubiginosus*, Hutton,² has been shown by Thiele³ to be typically a *Loboplax*, where Suter⁴ had previously referred it. But from *laqueatus*, Sow.,⁵ the type of *Craspedochiton*,⁶ that species can scarcely be separated. Indeed, I anticipate the reduction of *rubiginosus*, Hutton, to a synonym of *laqueatus*, Sow., when a longer series of the latter is examined. The ribbing of the head-valve of *Loboplax* is the chief character separating it from *Notoplax*; but, in a series of any species of *Loboplax* or *Craspedochiton*, that becomes faint, and in some cases obsolete. There seems no reason for the retention of *Notoplax*, when *Craspedochiton* is used as sectional under *Acanthochites*, which course has already been indicated by Smith.⁷

The difficulty of separating these *Acanthochites* into sections is well shown in Thiele's work. In the first part he generically uses *Spongiochiton*, *Loboplax*, *Notoplax*, and *Craspedochiton*. In the second he still retains *Craspedochiton*, but has eliminated *Loboplax* in favour of *Spongiochiton*, which he reduces to a sub-genus, whilst *Notoplax* becomes only a section of the latter. He had, however, introduced a new sub-genus and genus upon very slight characters, and these he retains. Our knowledge of the species of *Acanthochites* is too slight to form correct conclusions as to the variation in form in closely allied species, and at present the only safe way is to treat them broadly. A multiplicity of sections should not be founded on the variation of inconstant features. So few specimens of any Australasian *Acanthochites* have been handled, that it cannot be said that we know the limits of variation of any species.

ACANTHOCHITES CARINATUS, Ad. & Ang.

Acanthochites carinatus, Ad. & Ang., P.Z.S., 1864, p. 194; 1867, p. 224; Pilsbry, Man. Conch., vol. xv, p. 17.

This species, very definitely stated to have been found at Port Jackson, N.S.W., was never figured. Though a large and striking shell, it has never been refound. E. A. Smith (P.Z.S., 1891, p. 392)

¹ Pilsbry, Nautilus, 1893, vol. vii, p. 32.

² T.N.Z.I., 1871 (1872), vol. iv, p. 180.

³ Zool. Chun, 1909, Heft lvi, p. 38, pl. v, figs. 16, 17.

⁴ Journ. Malac., 1906, vol. xii, p. 68, pl. ix, figs. 12-17.

⁵ P.Z.S., 1841, p. 104.

⁶ Bern. Mittheil., 1853, p. 67.

⁷ Fauna and Geog. Maldive and Laccadive Archipel., vol. ii, p. 620.

examined the type, and reported that it seemed to be merely *A. discrepans*, Brown, a common European species. Pilsbry deemed this identification to need confirmation, as it was founded on an examination of external characters only.

I have disarticulated the specimen, and find there is no doubt whatever that the shell is simply *A. discrepans*, Brown. As all other European shells named by Adams as coming from Australia have been disallowed, I conclude *carinatus*, Ad. & Ang., must be omitted from the Australian lists, and must be added to the synonymy of *discrepans*, Brown.

ACANTHOCHITES (CRASPEDOCHITON) MARLÆ, Webster.

Acanthochites (*Loboplax*) *Marlæ*, Webster, T.N.Z.I., 1908, vol. xi, p. 254, pl. xx, figs. 1-11.

Loboplax Stewartiana, Thiele, Zool. Chun, 1909, Heft lvi, p. 37, pl. v, figs. 8-12.

I cannot separate Thiele's species from the one described very little earlier by Webster.

CHITON STANGERI, Reeve.

Chiton Stangeri, Reeve, Conch. Icon., 1847, pl. xxii, fig. 150; Hutton, Man. N.Z. Moll., 1880, p. 111.

Upon Hutton's suggestion Pilsbry included this species as a synonym of *C. canaliculatus*, Q. & G., Man. Conch., vol. xiv, p. 177. In 1897 Suter, revising the New Zealand Polyplacophora (Proc. Malac. Soc., vol. ii, p. 196), reintroduced it as a valid species for a specimen he had found at Lyttelton. He drew up a detailed description, pointing out how different it was from *canaliculatus*. Later I found also in Lyttelton Harbour two specimens, each of which were named for me by Mr. Suter from his specimen as *Stangeri*, Reeve. Examination of the type of *Stangeri*, Reeve, shows it to be merely *canaliculatus*, Q. & G., as Pilsbry placed it, and moreover very typically so, not even a variety.

CHITON SUTERI, n.sp.

Chiton Stangeri (*non* Reeve), Suter, Proc. Malac. Soc., vol. ii, p. 196.

At the place quoted Suter diagnoses this shell as follows: In size, shape, and coloration very much like *Chiton limans*, but differing on the following points. The ribs have no acute elevated grains, but are flattened. The tail-valve has very distinct, flatly nodulous ribs. The jugum is less acute, divergence 120° . The imbricating scales of the girdle are very small on both margins, larger in the middle, shining, not mucronated, and very faintly striated, the striæ being only visible under strong magnifying power. Length 13, breadth 8 mm.

Hab.—Lyttelton Harbour.

Type in Mr. Suter's collection.

This very distinct species is at present known by three specimens, all from Lyttelton Harbour. The shell I have used for comparison

with *Stangeri*, Reeve, is one named by Mr. Suter from his specimen described above. It is very slightly smashed and curled, and measures $11\frac{1}{2}$ mm. $\times$ $7\frac{1}{2}$ mm. The pleural areas are sculptured with six sulci, widely spaced and extending right across; the dorsal ridge quite smooth. The valves are beaked. The feature which separates it immediately from *canaliculatus*, Q. & G., is the sculpture of the pleural areas. In Pilsbry's monograph the peculiar wavy sulci of that species is well shown in fig. 4 of pl. xxxvi. The sulci of *Suteri* are perfectly straight, and much fewer than in a *canaliculatus* of the same size. I should even consider it nearer *areus*, Reeve, than either *limans*, Sykes, or *canaliculatus*, Q. & G., but whatever it is compared with it is an easily separable shell.

CHITON HULLIANUS, n.n.

Chiton Torri, Hedley & Hull (*non* Suter), Rec. Aust. Mus., 1909, vol. vii, p. 262, pl. lxxiii, figs. 6-11.

In honouring Dr. Torr, Messrs. Hedley & Hull overlooked the fact that Mr. Suter (Proc. Malac. Soc., 1907, vol. vii, p. 295, fig. 2 in text) had anticipated them in attaching Torr's name to a *Chiton*. In the hope that they have not corrected this error I am venturing to suggest the above to designate this South Australian species. In connexion with it and *Coxi*, Pils., I wish to point out that Thiele has published a new species, *bellulus*, from New South Wales (Zool. Chun, Heft lvi, p. 93, pl. x, figs. 5-8). This species was compared by Thiele with *jugosus*, Gld., but not with *Coxi*, Pils. Upon looking in the British Museum for specimens of the latter species, I could only find one from South Australia. I noted that this specimen differed from my recollections of shells of *Coxi* collected in Port Jackson when in company with Mr. Basset Hull, so I did not use it for comparison. I therefore certainly agree with Messrs. Hedley & Hull's remarks concerning the relationships of *Hullianus* and *Coxi*. I would like to note that when at Caloundra, Queensland, I collected one specimen of a new species, which, being very closely related to *Coxi*, Pils., may be its northern representative. There can be no doubt that *bellulus*, Thiele, is the same as *Coxi*, Pils., from a study of Hedley & Hull's beautiful figures.

SCLEROCHITON CURTISIANUS (Smith).

Chiton (Ischnochiton) Curtisianus, Smith, Zool. Alert, 1884, p. 78, pl. vi, fig. D.

Ischnochiton Curtisianus, Smith: Pilsbry, Man. Conch., vol. xiv, p. 97, pl. xxiv, fig. 6.

Liolophura Curtisiana, Smith: Pilsbry, loc. cit., pp. 242, 333.

Enoplochiton Torri, Bastow & Gatliff, Proc. Roy. Soc. Vic., 1907, vol. xx, p. 27, pls. iii, iv.

Sclerochiton Curtisianus, Smith: Thiele, Zool. Chun, Heft lvi, p. 96, pl. x, figs. 29-35.

S. Aruensis, Thiele, loc. cit., p. 96, pl. x, figs. 36-41.

Smith's *Curtisianus*, described from Port Curtis, Queensland, was transferred to *Liolophura* by Pilsbry, who had seen no specimens. In

the description the tail-valve was noted, as follows: Tail-plate much thicker within along the posterior edge, which is roughened by fine cross striæ, there being no prominent teeth and, of course, no notches.

Dr. Torr collected specimens at the type locality, and they were described as *Enoplochiton Torri* by Bastow & Gatliff. I have examined a syntype of this species, as well as the types of Smith's species, and of the identity of these two there is no doubt.

Sclerochiton miles, Pilsbry, was closely allied, but seemed generically separable by the presence of a toothed insertion plate in the tail-valve. Dr. Thiele has, however, referred *Curtisianus*, Smith, to *Sclerochiton*, and figured this species as having the tail-valve, with a slit insertion plate. Moreover, he gave good figures of a new species, *Aruensis*, from the Aru Islands, which, from a series of *Curtisianus* I myself collected at the type locality, was easily recognized as simply a young, well-sculptured shell of that species. He figured the insertion plate of the tail-valve as toothed for that species also.

Re-examination of the types of that species confirmed Smith's description, so I thereupon dissected some of my own shells, with the result that teeth were easily discernible, as in Thiele's specimens. I conclude that the method of dissection may have had something to do with the apparent lack in the types. I accordingly confirm Thiele's disposition, and add that specimens are present in the British Museum from Thursday Island. Bastow & Gatliff's reference of the species to *Enoplochiton* needs no consideration, as the type of that genus differs in every essential feature.

Hedley & Hull (Rec. Aust. Mus., 1909, vol. vii, p. 265) have noted that *Torri*, Bastow & Gatliff, is a synonym of *Curtisiana*, Smith, but misled, as I was, by the described character of the tail-plate, have transferred it to *Liolophura*. Re-examination of fresh specimens will certainly enable them to confirm its present generic disposition. Pilsbry reduced *Sclerochiton* to sectional rank under *Chiton*, but from examination of the type of this species and a Ceylon species I agree with Thiele in separating it as a valid genus.

ONITHOCHITON QUERCINUS (Gould).

Chiton quercinus, Gould, Proc. Bost. Soc. Nat. Hist., 1846, vol. ii, p. 142; U.S. Expl. Exped. Moll., p. 312, figs. 437, 437a; Otia Conch., p. 3.

C. (Onithochiton) quercinus, Gould, Otia Conch., p. 242.

C. Incii, Reeve, Conch. Icon., 1847, No. 94, pl. xvi, fig. 96, det. fig. 94.

Onithochiton rugulosus, Angas, P.Z.S., 1867, pp. 115, 223, pl. xiii, fig. 29.

O. Incei, Angas, P.Z.S., 1867, p. 223.

O. Lyellii (non Sow.), Pilsbry, Man. Conch., vol. xiv, p. 248 (*pars*).

O. quercinus, Gould: Pilsbry, loc. cit., p. 248, pl. lv, figs. 12, 13.

O. rugulosus, Angas: Pilsbry, loc. cit., p. 294, pl. lv, fig. 19; Proc. Acad. Nat. Soc. Phil., 1894, p. 88.

O. Incii, Reeve: Thiele, Zoologica Chun, Heft lvi, p. 99, pl. x, figs. 62, 63.

The last word on the *Onithochitons* of New South Wales is that by Pilsbry when he accepted "two species or at least forms" which he designated *rugulosus*, Angas, and *quercinus*, Gould, with the saving clause "Probably intergrades with the preceding" attached to the latter. That his caution was justified I am confident. In the first place, examination of the types of *rugulosus*, Angas, and *Incii*, Reeve, prove these names to be synonymous, with priority in favour of the latter. However, the figures of Gould are good enough to enable the identity of *Incii*, Reeve, and his *quercinus* to be established, so that of the published names *quercinus*, Gould, becomes the correct one to use.

Onithochiton Lyellii, Sow., has been quoted from Australia, but it is a Pitcairn Island shell, quite distinct, though no doubt closely allied. I have closely examined many specimens from New South Wales and Queensland, and though there sometimes appear the two forms quoted by Pilsbry I cannot keep them separate. However, *rugulosus*, Angas, is *absolutely* identical with *Incii*, Reeve, and cannot be used for a form, the latter having priority. My examination of Reeve's type leads me to say the same when it is compared with Gould's figures of *quercinus*.

Thiele has pointed out at the quotation given that *Incii*, Reeve, is distinct from *Lyellii*, Sow. On the same page he introduces a new species of *Onithochiton* as from New South Wales, which I comment upon in the succeeding note.

ONITHOCHITON SCHOLVIENI, Thiele.

Onithochiton Scholvieni, Thiele, Zool. Chun, 1909, Heft lvi, p. 99, pl. x, figs. 60-1.

Upon a tablet in the British Museum labelled *Onithochiton Incii*, Reeve, were four specimens of a large new *Onithochiton*. They were quite dissimilar to that species, and I had dissected one to prepare a description. Upon receipt of Dr. Thiele's paper I recognized at once my shell under the above name. I only wish here to draw attention to the locality of Dr. Thiele's specimens. They were supposed to have come from New South Wales, but I cannot believe that. The specimens in the British Museum are labelled "West Australia", which seems to me more correct.

ON *UNIO*, *MARGARITANA*, *PSEUDANODONTA*, AND THEIR
OCCURRENCE IN THE THAMES VALLEY.¹

By FRITZ HAAS, Frankfurt.

Read 11th February, 1910.

IN the Journal of Conchology, 1909, vol. xii, p. 321, Mr. J. W. Jackson and Mr. A. S. Kennard mention the occurrence of *Unio margaritifer* in the Pleistocene strata of the Thames.

As a special feature of the shells, which according to the description are exceedingly well preserved, they mention the so-called "Thames mark"—an incrustation of carbonate of lime. This fact puzzled me considerably, since, according to my own experience, the pearl mussel lives only in water completely or almost free from lime. Such water always contains large quantities of carbonic acid in solution, which, after the death of the mussel, dissolves the lime of the shell, and only the conchyolin layer remains. This fact, so well known to all zoologists and biologists, cannot be reconciled with the presence of an incrustation on *U. margaritifer* from the Thames strata. A fortunate circumstance materially assisted in explaining this apparent contradiction.

About two years ago shells of *U. sinuatus*, Lam., a species not known to occur in the Rhine in a living state, were discovered in Holocene strata of the Rhine, near Ludwigshafen. I was aware that this shell, which bears some superficial resemblance to the pearl mussel, had long been confounded with it, and that Rossmässler² was the first to separate the two forms. It appeared to me not impossible that English naturalists had made the same mistake as Rossmässler's predecessors. Mr. A. S. Kennard had the great kindness to send me a specimen of the Thames mussel in question, and it proved to be, in fact, *U. sinuatus*.

I was struck by the coincidence that both in Jackson & Kennard's above-mentioned article and in the Census of the British Land and Freshwater Mollusca issued by the Conchological Society of Great Britain and Ireland, the pearl mussel—Linné's *Mya margaritifera*—is given under the name of *Unio margaritifer*, although Schumacher,³ as far back as 1817, removed this species from the genus *Unio*, to which it had been referred by Retzius, and created for it the genus *Margaritana*. This separation was based on the difference in structure of the hinge between *Unio* and the pearl mussel, which possesses only cardinal teeth and no laterals, and was universally recognized especially since in the anatomy of the soft parts important distinctions between the two were observed. Those who consider the absence of laterals insufficient reason for generic separation of the pearl mussel from *Unio* will probably find conclusive proof in the following comparative

¹ Translated from the German text by G. K. Gude.

² Rossmässler, Iconographie, 1836, Heft iii, p. 22, pl. xiii, fig. 195.

³ Schumacher, Nouveau système vers test., 1817, p. 137.

anatomical and embryological characters of the two genera in question tabulated in parallel columns:—

UNIO.

MARGARITANA.

Animal having the inner branchiæ free from the abdominal sac for from one-half to their entire length; gills united to the mantle behind to their extreme points or very nearly so; papillæ on branchial and anal openings unbranched; superanal openings always closed below.¹

Animal with very long gills, inner wider in front, free for the greater part of their length from the abdominal sac, the two pairs united to their posterior ends, which project backwards for some distance unconnected with the mantle; branchial opening having crowded, often arborescent papillæ arranged in folds; anal opening smooth or crenulate; superanal opening not closed below.²

Eggs developed only in the outer gills of the female into a glochidium 0.29 mm. in length, possessing two triangularly rounded flattened shells connected by means of an inner basal ligament [adductor muscle].

Eggs developed both in the outer and inner gills of the female into a glochidium only 0.0475 mm. in length, and possessing rounded, extremely convex shells, which, when closed, give it a globular form.

Of the two sides of the triangle the anterior is the greater. At the apex of each occurs a strong hook, bent inwards, which is provided with numerous minute teeth.

The two sides of the shells are almost equal. True hooks are wanting. In their place one observes at the apex of the shell 6-7 attenuated hooks bent forward and inward.

Larval threads (byssus threads) present.³

Larval threads (byssus threads) present.³

To return to *Unio sinuatus*. A true *Unio*, the hinge being provided with cardinals and laterals and described in 1819 by Lamarck⁴ as follows: "*Unio testa ovato-oblonga, superne coarctato-sinuata, crassa; natibus subprominulis; dente cardinali crasso, lobato, striato.*"

Mya margaritifera (?), Linné: Gmelin, p. 3219; Lister, Conch., pl. cxlix, fig. 4; Knorr, Vergn., vol. iv, pl. xxv, fig. 2; Schröter, Flusse., pl. iv, fig. 1; Drap., Hist. Moll., p. 132, pl. x, figs. 8, 16, 19; Ency., pl. ccxlviii, figs. 1a, b.

In the diagnosis quoted above the lateral lamellæ are not mentioned. This circumstance, together with the citation of the figures of *Margaritana margaritifera* of Lister, Schröter, and Draparnaud, leads to the conclusion that *Unio sinuatus* was considered to be related to *U. elongatus*⁵ (a true *Margaritana* being, in fact, the narrow

¹ After Simpson, 1900, Proc. U.S. Nat. Museum, vol. xxii, p. 680.

² After Simpson, *ibid.*, p. 674.

³ After Harms, 1909, Zool. Jahrb., Abth. für Anat. u. Ont., Band xxviii, Heft ii.

⁴ Lamarck, 1819, Hist. Nat. Anim. sans Vert., vol. vi, p. 70.

⁵ Loc. cit., p. 70.

elongated local form peculiar to England) and both looked upon as varieties of the pearl mussel. This conclusion receives further support from the fact that Lamarck compares the shapes of the two: "Elle [i.e. *U. elongatus*] est, proportionnellement, plus étroite, plus allongée, et moins sinueuse que la précédente [i.e. *U. sinuatus*]." Deshayes, who edited the second edition of Lamarck's *Histoire naturelle des animaux sans vertèbres*, and had access to his collection, recognized the true affinity of *U. sinuatus* from Lamarck's type-specimen and omitted from the text the erroneous citations referring to *Margaritana margaritifera*. The retention of the reference to *Encyclopédie méthodique*, pl. cexlviii, figs. 1a, b, already given in the first edition, on the other hand, leaves, as first pointed out by Rossmässler, one illustration — certainly not conspicuous for its excellence — of *U. sinuatus*.

In spite of these facts doubt has been expressed, quite recently, as to the correct generic position of our species. Simpson, in his Synopsis, already cited, p. 678, considers *U. sinuatus* a form of *U. crassus*, Retz., which, curiously enough, he refers to *Margaritana*. With regard to the relation of *U. sinuatus* to *U. crassus* I need simply mention that, apart from the external aspect which causes the latter to appear as a miniature representation of the former, the two species have nothing in common. How Simpson can regard *U. sinuatus* as a *Margaritana* appears to me totally inexplicable, especially since in the foot-note to his *Margaritana crassa* he mentions the presence of well-developed laterals. Moreover, according to the anatomy of the soft parts of a specimen from Wandersleben in Thuringia¹ dissected by me, it is a true *Unio*.

After these discursions I trust *Unio sinuatus* will be left in peace and will not have to continue further perambulating from one genus to another.

I will now refer very shortly to the other *Unios* living in the Thames Valley. My brother, who resides in England, and to whom I am indebted for nearly all my English Naiades, collected for me *U. pictorum*, L., and *U. tumidus*, Retz., but was unable to find a single specimen of *U. Batavus*, Lam. This absence of the commonest *Unio* in all running waters on the European Continent is confirmed in the Census of the British Land and Freshwater Mollusca, but is in direct contradiction to the statement by Maton & Rackett,² who described their *Mya Batava* from the River Kennet in Berkshire, therefore from the Thames Valley. On the other hand, the remarks of these two English authors, whose quick eyes did not fail to detect differences in structure of the hinges of other mussels, on the hinge of their *Mya Batava* ("cardo ut in *Mya pictorum*") gives the impression that they

¹ Retzius (Diss. Hist. Nat., 1788, p. 17) cites after the diagnosis of his *Unio crassus*, Schröter, Flusssconchylien, 1779, pl. ii, fig. 2, as illustrating his species. The specimen there figured, called by Schröter *Mya testa crassa*, originated from Wandersleben in Thuringia, and for this reason I attached much importance, in my anatomical investigations of the European Naiades, to the fact that I could examine specimens of *U. crassus* from Schröter's original habitat.

² Maton & Rackett, Trans. Linn. Soc. London, 1807, vol. viii, p. 37.

had before them stunted, abnormally rounded shells of *U. pictorum*; the addition of the term *rarissima* also supports this view. Mr. Kennard, whose opinion on the subject I solicited, also concludes that they were misled by an erroneous identification.

The specimens of *U. pictorum* and *U. tumidus* collected in the Thames at Surbiton by my brother are characterized by sharply defined bronze-coloured nepionic shells, which show the apical sculpture peculiar to each.

From the Pleistocene of the Thames Valley a *U. littoralis* has been described, as also from the Pleistocene of the Rhine near Mosbach. On careful comparison with recent specimens of *U. littoralis* the Mosbach form was found to differ from the former in the structure of the hinge, which led me to describe it as a new species under the name of *U. Kinkelini*.¹ Through the courtesy of Mr. Kennard I received from Pleistocene sand of three different ages from the South of England several specimens of the so-called *U. littoralis* which correspond with the Mosbach form in a peculiar manner. Whilst the shells from the geologically oldest habitat, Swanscomb, were almost identical with my *U. Kinkelini*, those from Crayford differed somewhat from the type, and the geologically most recent habitat, Clacton, produced specimens almost identical with *U. littoralis* from the North of France. The principal character of *U. Kinkelini* I considered to be the blunt hinge, which was further distinguished from the somewhat neat hinge of *U. littoralis* by the possession of several auxiliary teeth. The English forms constitute in the before-mentioned sequence a complete transition from typical *U. Kinkelini* to *U. littoralis*, so that the Mosbach form is not so isolated as I concluded at first.

According to the Census of the British Land and Freshwater Mollusca no *Margaritana* occurs in the Thames Valley. In view of the abundance of lime in the water of the Thames the absence of this genus is not surprising, since, as I have already mentioned, *Margaritana* only occurs in water deficient, or nearly so, in lime. As a proof how extraordinarily sensitive the pearl mussel is as regards water rich in lime the following experience may be adduced. During nine months I kept alive several specimens of *Margaritana margaritifera* in Heidelberg water destitute of lime, which, upon being placed in water from Frankfurt-a.-M. containing comparatively little lime, died in a few hours.

I am indebted to my brother for the discovery of a mussel which appears hitherto to have been overlooked not only in the Thames but in the whole of England, as I find no reference to its occurrence in the Census. Although represented only by a single, but unmistakable specimen from the Thames at Molesey, I have before me the species of *Pseudanodonta*, Bourg., living in Germany in the Rhine district, i.e. *P. elongata*, Hol. Many authors, knowing the genus *Pseudanodonta* only from figures, have referred its various forms—*complanata*, Zglr., *elongata*, Hol., *borealis*, Kob., etc.—to *Anodonta*, since these two genera agree in the absence of teeth on the hinge and in some other particulars.

¹ *Unio Kinkelini*, Haas, Nachr. Blatt. Deutsch. Malak. Ges., 1908, p. 117.

As, however, many, and to my mind important, differences exist in the structure of the shells and in the anatomy of the soft parts, I consider the retention of the genus *Pseudanodonta*, as defined by Bourguignat, quite justified. As living *Pseudanodonta*s from the Rhine, the Neckar, and the Danube were at my disposal for anatomical investigation, I am enabled to subjoin a diagnosis based on shell and anatomical characters as compared with those of *Anodonta*.

PSEUDANODONTA.

Shell rhombic, more or less elongated, thin, *much compressed*, almost without wings, gaping behind; *beak sculpture consisting of few isolated, rather elevated tubercles*; surface usually smooth, shining; hinge edentulous, reduced to a mere line, *never curved*; muscle-scars rather faint.

Animal having the gills free about half the length from the abdominal sac; palpi rather long; branchial orifice papillose, darkly coloured; *anal orifice with small but true papillæ*, darkly coloured; superanal orifice closed behind. *Gills very soft*; the eggs develop in the outer gills of the female into a glochidium 0.33 mm. in length. It is very convex, rounded triangular in form, provided with rather short blunt hooks, and is without a larval thread.

ANODONTA.

Shell elliptical, thin, *inflated*, mostly winged posteriorly; *beak sculpture consisting of rather numerous parallel ridges*, usually somewhat doubly looped; surface generally smooth, shining; hinge edentulous, reduced to a mere line, *seldom curved*; muscle-scars rather faint.

Animal with the gills free from the abdominal sac from one-half to their entire length; palpi generally large; branchial opening papillose, darkly pigmented; *anal opening without papillæ, but sometimes very slightly crenulate*, darkly pigmented; superanal opening small, widely separated from the anal.¹

Gill rather solid; the eggs develop in the outer gills of the female into a glochidium 0.35 mm. long. It is rather flat, rounded triangular in form, provided with large narrow hooks, and has a larval thread.

To my knowledge a more correct anatomical and embryological description of *Pseudanodonta* has not hitherto been published. The distinctive characters of this genus may be further multiplied; the formation of the ova differs considerably from that of *Anodonta*,² the nearest approach being observed in *Unio*. According to Schierholz³ the bundles of sensory threads peculiar to glochidia are differently arranged in the glochidium of *Pseudanodonta* from those of *Anodonta*. In this respect the conditions remind us of those obtaining in the glochidium of *Unio*. I will not here refer to the histological structure of the gills, although this exhibits important differences in the two

¹ After Simpson, Synopsis of the Naiades, 1900, p. 620.

² Flemming, Archiv f. Mikro. Anat., 1874; Sitz. Ber. Math. Nat. Akad. Wien, 1875, vol. lxxi.

³ Schierholz, Denkschr. Kais. Akad. Wiss. Wien, Math. Nat. Cl., 1888.

genera. I think the characters indicated in the foregoing comparative tables are sufficient to demonstrate the claim to generic rank of *Pseudanodonta*.

I possess a specimen of *Pseudanodonta elongata*, Hol., from the Thames. This species occurs in the identical form in the Upper Rhine, the Neckar, the Main, the Moselle, the Lower Rhine, and the Meuse, and is probably represented also in the Schelde and Seine. It differs from *P. complanata* from the Danube, the type of the genus, in its dwarf elongated form. Other species, still unnamed, occur in the Weser, the Elbe, the Oder, and in Sweden. Hanley¹ states that in Linné's collection the box with *Anodonta anatina* contains a *Pseudanodonta* which corresponds exactly with the figure in Rossmässler, Icon. iv, pl. xx, fig. 283. The figure of this Linnean *Pseudanodonta*, however, represents a true *A. anatina* in its elongated state, exactly like those I have from Sweden. Misled by this error on Hanley's part, Simpson treats *Pseudanodonta* simply as *Anodonta*, and places it in his Synopsis under the comprehensive *A. cygnea*.

In conclusion, and in order to complete the consideration of the Unionidæ of the Thames, I must refer to the English Anodontas. In this connexion a question crops up which can only be settled by the examination of Linné's collection of shells. It is with respect to the nomenclature of the species of *Anodonta*, which in Germany, through Rossmässler's influence, is treated in quite a different way from that in England. Hanley certainly states that Linné's *A. cygnea* corresponds with the figure in the Iconographie, pt. iv, pl. xix, fig. 280, indicated by Rossmässler as *A. Cellensis*, Schröt. Unfortunately Hanley's error in connexion with *Pseudanodonta*, already referred to, has shaken my confidence in him in such a manner that I will not at present attempt to settle this question of nomenclature, but must defer this until my visit to London. In order, however, not to be misunderstood by my English readers I will quote with each specific name the respective figures in Rossmässler's Iconographie. In Germany we distinguish only two species of *Anodonta*—*A. Cellensis*, Schröt. (Icon., pl. xix, fig. 280), and *A. piscinalis*, Nilss. (Icon., pl. xix, fig. 281). *A. anatina*, L. (Icon., pl. xxix, figs. 417–20), is considered to be a degenerate form of *A. piscinalis*, as found in brooks with a strong current. *A. cygnea* (Icon., pl. iii, fig. 67) is a convergent form between *A. Cellensis* and *A. piscinalis* found in pools and ponds with deep tenacious mud. I will not here consider the other forms of *Anodonta*, and only refer to my article on "Die Najadenfauna des Oberrheins vom Diluvium bis zur Jetztzeit".²

I possess *A. piscinalis*, Nilss., in quite typical form from the Thames at Surbiton. This species is also conspicuous—as far as the specimens from this locality are concerned—for the sharply defined nepionic shell.

A. Cellensis, which prefers still water, will hardly be found in the

¹ Hanley, Ipsa Linnæi Conchylia, 1858, p. 144.

² Abh. Senckenb. Naturf. Ges., 1910.

Thames. But from the Serpentine in Hyde Park, which, as far as I know, is connected with the Thames, I have *A. Cellensis*, var. *cygnea*.

In conclusion, I may mention that the Unionidæ of the Thames have a great resemblance to those of the Rhine, so that zoogeographers can confirm the assumption of geographers and geologists, that previous to the formation of the German Ocean the Thames was a left tributary of the Rhine. For further details I would refer to my article, already alluded to, where this question is further elaborated. This short article must not be considered a monograph of the Naiades of the Thames; it is simply intended to fix the distribution in England of the four North European genera of Naiades, in order to prepare the way for a real monograph of the Unionidæ of the British Isles, based on zoogeographical data. It will be a great source of satisfaction to me if these remarks should stimulate an interest for the Unionidæ in England, and be the means of obtaining some converts on the other side of the British Channel for my distinguished friend and teacher, Dr. Kobelt, founder of the comparative investigation of rivers by means of the Unionidæ,¹ who this year, on February 20th, celebrated his 70th birthday.

¹ Kobelt, Nachr. Blatt. Deutsch. Malak. Ges., 1908, p. 49.

DESCRIPTION OF *VIVIPARA FRAGILIS*, N.SP., FROM
DUTCH NEW GUINEA.

By H. B. PRESTON, F.Z.S.

Read 11th February, 1910.

VIVIPARA FRAGILIS, n.sp.

Shell fusiformly turbinate, obtuse, much eroded, reddish chestnut; whorls 5, convex, shouldered above, bearing three spiral carinæ, marked with transverse lines of growth, and sculptured with numerous raised, wavy, spiral striæ, which become more numerous towards the base; sutures deeply impressed; umbilicus narrow; columella



rather obliquely curved; peristome slightly thickened below, erect above, continuous, blackish; aperture subcircular; operculum horny with sub-lateral nucleus. Alt. 40, diam. maj. 30 mm.; aperture, alt. 19, diam. 16 mm.

Hab.—Manswön Bien Lake, Central Arfak Mountains, Dutch New Guinea, at an altitude of 8000 feet.

ON AN UNDESCRIBED *ANODONTA* FROM THE ENGLISH
WEALDEN FORMATION, WITH REMARKS ON THE OTHER
UNIONIDÆ OF THE SAME PERIOD.

By R. BULLEN NEWTON, F.G.S.

Read 11th February, 1910.

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PLATE I.

THE typical Wealden deposits of the South of England occupy a large tract of Sussex, Kent, and Surrey, which is enclosed by the Chalk escarpments of the North and South Downs. Extensions of the same formation occur beyond this region, more especially in the Isle of Wight and Dorsetshire. These strata have yielded a remarkable fauna and flora, such as minute Ostracoda, delicate insect remains, mollusca, fishes, reptiles of great size like the *Iguanodon*, ferns, cycads, and other plants. All these organisms serve to indicate that the deposits containing them were of an estuarine or lacustrine character, and that freshwater conditions prevailed during their period of sedimentation. A considerable literature exists on the Wealden fossils, the basis of which is to be found in the works of Gideon Algernon Mantell, mostly published between 1822 and 1851. For our knowledge of the Unioniform mollusca of this period we are, however, almost entirely dependent on the writings of James de Carle Sowerby,¹ who described, as early as 1828, several forms of *Unio* collected by Mantell from quarries in the Tilgate Forest area of Sussex, as well as some further species in 1836-7 from Sussex localities, also collected by Mantell, which were in illustration of W. H. Fitton's memoir "On some of the Strata between the Chalk and the Oxford Oolite". In 1844 Mantell² described and figured in outline the now well-known *U. Valdensis* which he had discovered in the Wealden beds of the Isle of Wight (near Brook), comparing it with some of the recent massive forms of that genus found in North American waters, such as *U. purpuratus*. Further figures of this species were published in 1846 by James de Carle Sowerby,³ but without text, Mantell⁴ also issuing in the following year some excellent illustrations of the same shell, with an extended notice of its history.

The species of *Unio* thus referred to comprise *aduncus*, *antiquus*, *compressus*, *cordiformis*, *porrectus*, *Mantelli*, *Martini*, *Gualteri*, and *subtruncatus*, all of Sowerby, whilst the history of *Valdensis*, as stated, is entirely due to Mantell. It is of interest to mention that with the exception of two of these species (*Gualteri* and *subtruncatus*)

¹ J. de C. Sowerby, Mineral Conchology, 1828, vol. vi, pp. 189-92, pls. 594-5, and Trans. Geol. Soc. London, 1836-7, ser. II, vol. iv, p. 346, pl. xxi, figs. 14-17.

² Mantell, Amer. Journ. Sci. (Silliman), 1844, vol. xlvii, pp. 403-6, figs. 1-3.

³ J. de C. Sowerby, Mineral Conchology, 1846, vol. vii, pl. 646.

⁴ Mantell, London Geological Journ., 1847, No. 2, pp. 41-4, pl. xiv.

the remaining types are preserved in the British Museum. Although new material has come to hand since this early work was accomplished, no attempt has since been made by palæontologists in this country to increase our knowledge of these freshwater shells, but through the researches of Koch,¹ Dunker,² Struckmann,³ Parent,⁴ and others, we learn that some of the English species of *Unio* are closely related to certain forms found in the Wealden areas of Germany, France, etc.

The Spanish Wealden beds also exhibit a similar resemblance, Messrs. Palacios & Sanchez⁵ having discovered a large *Unio* showing affinities with the English *Valdensis*.

With regard to the genus *Anodonta*, one of the edentulous members of the Unionidæ, it may be said to be of particularly rare occurrence in rocks of Mesozoic age, and the species about to be described from the Wealden strata is probably the oldest authentically known from this or any other country. Certain species have been published which have since been relegated to other genera, as for instance Quenstedt's⁶ *Anodonta lettica*, as well as *arenacea* and *dubia* of Oscar Fraas,⁷ all from the German Trias, which Alberti⁸ has recognized as belonging to his genus *Anoplophora*.

Again, Mathéron's⁹ *U. Gardanensis*, from the uppermost French Cretaceous, although placed by some authors in *Anodonta*, is more probably a form of *Spatha*, as suggested by Sandberger.¹⁰ The latest Cretaceous beds (Laramie Group) of North America have, however, produced a well-recognized form of the genus in *Anodonta propatoris* of C. A. White,¹¹ which is said to have the general aspect of modern types of this genus as found in the rivers of that country.

In Palæozoic times there thrived a large freshwater shell which had been described by W. H. Baily as *Anodonta Jukesi*, but which has since been recognized under the genus *Archanodon* of Howse.¹²

Ludwig¹³ has reported a number of shells as *Anodonta* from the Palæozoic freshwater deposits of the Oural country, but from an

¹ Koch & Dunker, Beiträge Norddeutschen Oolithgebildes Versteinerungen, 1837, pp. 58-9, pl. vii.

² Dunker, Monographie Norddeutschen Wealdenbildung, 1846, pl. xi, pp. 26-8.

³ Struckmann, Die Wealden-Bildungen von Hannover, 1880, pls. i, ii, pp. 64-70.

⁴ Parent, "Le Wealdien du Bas-Boulonnais": Ann. Soc. Géol. Nord, 1893, vol. xxi, p. 50.

⁵ Palacios & Sanchez, "La Formacion Wealdense Soria y Logrono": Bol. Com-mapa Geol. Espana, 1885, vol. xii, pp. 136-8, pls. vi, vii.

⁶ Handbuch der Petrefactenkunde, 1852, pl. xlv, fig. 16, p. 529.

⁷ Oscar Fraas, "Ueber *Semionotus* und einige Keuper-Conchylien": Württembergische Nat. Jahresh., 1861, vol. xvii, pp. 81-101, pl. i.

⁸ F. von Alberti, Ueberblick über die Trias, 1864, pp. 133-41.

⁹ P. Mathéron, Catalogue méthodique et descriptif des Corps Organisés Fossils, Bouches-du-Rhône, 1842, p. 170, pl. xxiv, figs. 4, 5.

¹⁰ F. Sandberger, Die Land- und Süßwasser-Conchylien der Vorwelt, 1871, Heft iii, p. 95.

¹¹ C. A. White, 12th Ann. Rep. U.S. Geol. Surv. Territories for 1878, part i, 1883, p. 61, pl. xxiv, fig. 2.

¹² R. Howse, Nat. Hist. Trans. Northumberland, 1878, vol. vii, p. 173, pl. xiv; and R. B. Newton, Geol. Mag., 1899, pp. 245-51.

¹³ Ludwig, Palæontographica, 1861, vol. x, pp. 19-22, pl. iii.

examination of the types these have been considered by Mr. Wheelton Hind¹ as belonging to the genus *Carbonicola*.

Some few forms of *Anodonta* are found in Tertiary formations, although the evidence seems to prove that probably from a generally thin and delicate shell-structure, the genus is sparingly distributed geologically, and that so far as can be ascertained no true examples appear to be known below the Wealden formation.

ANODONTA BECKLESII, n.sp.

"A large *Anodon* (?)," S. H. Beckles, "On the Lowest Strata of the Cliffs at Hastings": Quart. Journ. Geol. Soc., 1856, vol. xii, pp. 291, 292.

Description.—Valves oblong, suboval, sometimes sub-quadrangular, thin-tested, length usually about $1\frac{1}{2}$ times in excess of the height, widely inflated over the umbonal region, afterwards compressed to the margins; dorsal line well below umbonal region, straight, nearly parallel with ventral margin, angulated at both ends; anterior side short, well rounded; posterior surface oblique, wide, much depressed, produced, obliquely margined, subangulate at ventral corner, furnished with a prominent, more or less concave, obtuse ridge extending from the umbones to the postero-ventral angle, followed by one or two obscure oblique costæ, which, like the ridge, originate at the umbones; ventral margin extensive and curved; umbones anterior, more or less polished, bending inwards, having the dorsal margins of umbonal region elongate, flattened, and nearly parallel with each other; sculpture consisting of periodical, nearly equidistant, concentric growth-lines, with finer striations within, which become subangulate at the postero-ventral corner, and then assume an upward oblique direction to meet the dorsal margin. Crossing the concentric lines is a series of extremely fine and elevated, mostly equidistant, radial striations which extend from the umbones to the margins, occurring occasionally in pairs, and frequently interrupted, when the broken lines exhibit fine tapering ends which are laterally disposed without touching. Between the main radial striations are numerous finer lines taking the same direction. Hinge characters unknown.

Dimensions of two examples in millimetres.

	A	B
Height	92	78
Length	144	100
Umbonal diameter of both valves when closed .	30	20

Remarks.—This description applies to a generally large form of *Anodonta*, examples of which in the British Museum were collected by Mantell, Samuel Beckles, and in more recent years by the late Philip Rufford. Beckles, as far back as 1856, referred "to a large *Anodon* (?)" being found in the Hastings deposits, which probably included the form now described, although his statement might also have had reference to a much larger freshwater bivalve commonly found in this formation, but which, from a recent examination of

¹ W. H. Hind, Mon. Pal. Soc., 1894, p. 24.



ley photo.

3



4



x3



ANODONTA BECKLESII, N.SP.

partial internal characters, may now be pronounced as belonging to the true *Unio*. Some of these latter shells actually bear manuscript names written by Mantell and Beckles, indicating that they were regarded as *Anodonta*. The characters of the species under description are spread over two or three specimens in different states of preservation, although unfortunately without details of the hinge, as none have been successfully developed in that region. An interesting point of this shell is its general resemblance to *Anodonta propatoris* of C. A. White from the Upper Cretaceous (Laramie Beds) rocks of the United States, and also to some modern forms living in North American rivers, especially that known as *A. Stewartiana* of Reeve (*Conchologia Iconica*, 1870, pl. xxxiii, species 133), thus showing the persistence of one particular type of this genus from Wealden to modern times. But although exhibiting a similarity of contour, the Wealden shell is much more compressed and larger, whilst the ornamentation appears to separate it from anything seen either in a recent or fossil form. The radial striations are better exhibited on a specimen displaying a dorsal view of both valves in the closed condition. It is possible that such markings represent the position of the original colour-streaks which may have been a feature of the valves during the life of the mollusc, as is common among recent *Anodonta* and the shells of the Unionidæ generally. Probably the outer shell-structure is not present, in which case the ornamentation seen would occur just below it, because in the modern *A. cygnea* radial striations are observable on the nacreous layer which lies beneath the outer shelly covering. The species is in other ways well characterized, especially in connexion with the marked angularity of the lateral aspect of the valves, the posterior region being strikingly developed.

The specific name proposed is in memory of a former geologist, S. H. Beckles, F.R.S., who was one of the earlier authorities on the geology and fossils of the deposits in the neighbourhood of Hastings.

Occurrence.—Examples of this species are found in the 'Fairlight Clays', which is the basal division of the Wealden beds near Hastings, having been obtained from between Ecclesbourne and Fairlight Glen. They occur in grey-coloured sandstones, reddish ironstone, and softish drab clays, being sometimes accompanied on the same matrix by fragmentary plant remains.

EXPLANATION OF PLATE I.

Anodonta Becklesi, n.sp.

Wealden (Fairlight Clays). Near Hastings.

- Fig. 1. Specimen with extended valves on matrix, showing excavated posterior ridges, radial lineations, etc. [P. Rufford Coll., British Museum, L. 6244.]
- „ 2. Right valve, of a subquadrate form, attached to matrix. [P. Rufford Coll., British Museum, L. 6228.]
- „ 3. Dorsal view of an example with closed valves, exhibiting smooth umbonal regions and wide posterior area. [S. H. Beckles Coll., British Museum, L. 8384.]
- „ 4. Details of sculpture-markings as observed on specimen represented by Fig. 3, $\times 3$, showing the disjointed character of the filiform radial striations.

Note.—The figures on this Plate are of the natural size, with the exception of Fig. 4, which is a magnification.

NOTES ON (I) PLEISTOCENE, (II) HOLOCENE, (III) RECENT NON-MARINE SHELLS FROM MALLORCA; (IV) MARINE SHELLS ASSOCIATED WITH THE HOLOCENE DEPOSITS; (V) MARINE SHELLS FROM ALCUDIA, MALLORCA; (VI) NON-MARINE SHELLS FROM MANRESA, CATALUÑA.

By Rev. R. ASHINGTON BULLEN, B.A., F.I.S., F.G.S.

Read 11th March, 1910.

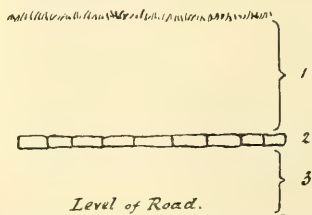
THE list of shells from Mallorca need a few words of explanation, otherwise they are principally useful as localizing certain species, a sort of pioneer work which may some day prove advantageous.

I. PLEISTOCENE.

The Pleistocene forms are interesting principally as having been found by Miss Dorothea M. A. Bate in the same deposits in which she discovered *Myotragus Balearicus*, Bate, last spring, as described in the Geological Magazine, 1909, p. 385. The Quaternary rocks of Majorca and Minorca are discussed by Henri Hermite.¹ It is not necessary to go into the geological questions involved, otherwise than saying that he mentions the occurrence of *Helix Companyoni*, Aléron, in deposits containing many (still existing) marine species near Palma; also near Andraitx *H. Companyoni* and *Tudorella ferruginea*, Lam., and near Coll d'en Rebasa the two latter with *Bulimus* sp. and *Helix Caroli*, Dohrn (var.). However, it behoves one to say that as these Quaternary rocks are not differentiated sufficiently from one another, it is uncertain whether these deposits, containing the above-mentioned land shells, are to be regarded as Pleistocene or Holocene; if the level at which they occur were known we might be more certain of the epoch to which they severally belong. The four species found by Miss Bate are definitely Pleistocene, having been found in company with a now extinct mammal.

II. HOLOCENE.

Porto Pi.—The shells found here occurred in a hill-wash down to a depth of 8 feet. The section was well-defined, near the end



of the mule tram-car line from Palma, about 3 miles out from the latter place. The face nearest the road contained (besides the non-marine mollusca) specimens of marine mollusca and some fragments of

¹ "Études géologiques sur les îles Baléares" (Première Partie), Paris, 1879, pp. 277-99.

pottery, the thick blackish pottery with yellow glaze being found about 5 feet down. I noticed no pottery of this type of colour in the market at Palma. The other fragments were nearer the surface. The pottery and marine shells probably are derived from refuse material and seaweed, used to fertilize the soil, for the island has been agriculturally occupied certainly from Phœnician times and probably much earlier. The depth of the deposit gradually thins off up the hill above. The section observed is a considerable distance in from the sea-front, and about 60 feet above sea-level.

1. Overburden (containing non-marine and marine mollusca and pottery) varying from 6–8 feet in thickness.
2. Sandy limestones 10–15 inches in thickness.
3. Red crumbly clay.

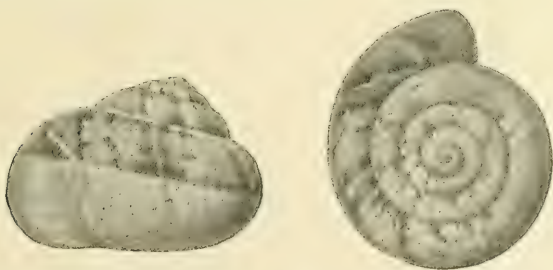
Alcudia.¹—The Holocene deposits at Alcudia form a low sea-cliff quite near the sea, there being very little foreshore—in some parts none. The farmers use seaweed for manure, and this probably accounts for the mixture of non-marine and marine shells in the course of ages. The land has a slight slope downwards to the sea-front, and the soil has no doubt been washed down in that direction, and caused the mélange.

Manresa.—These Holocene deposits were near the bridge above the railway, and were in places quite 10 feet thick.

III. THE RECENT NON-MARINE MOLLUSCA.

Bellver.—The hill on which Bellver Castle stands is about 350 feet O.D., and is very rich in mollusca. The Holocene deposit was near the summit of the hill.

Alcudia (Port of).—The recent land and freshwater mollusca were found on the large stretch of blown sand, with swampy bits of land in parts of it, which is dammed off from the sea by a strand of natural concrete containing abundance of *Cerithium vulgatum*, *Conus mediterraneus*, and *Helix Pisana*, etc. The whole of the shells from Alcudia were procured in less than two hours.



One of the land shells from Porto Pi deserves a note specially to itself. It was found adhering to a rock in the full blaze of sunlight,

¹ The old walled Roman town of Alcudia is a mile from the sea; we are dealing with the fishing village.

and looked quite dead when boxed. Six weeks afterwards on being unpacked it was found to have made a fresh epiphragm. It was sent to the Rev. E. H. Bowell, who has, however, not yet reported upon its radula. Its shape and markings are seemingly abnormal, but there are suggestions of *H. aspersa* in its colouring. Its primary whorls most closely resemble a specimen of *Otala vermiculata*, Müll., from the same place, and it may be provisionally placed with that species. It is perhaps, however, a hybrid between *O. vermiculata* and *H. aspersa*. (See figure on p. 119.)

In conclusion I have to thank Dr. Böttger and Messrs. G. K. Gude and A. Santer Kennard for identifications of critical species.

NOTE.—Recent shells, Palma, Mallorca. On March 10th, 1909, returning from the railway station round the walls on the west of Palma, we passed a number of trees (probably plane-trees) with bare patches surrounded by bark. Numerous young snails were in these hollows glued to the trees and varnished over by the exudation of gum from the wounded trees. It was curious to see so many hundreds of young snails thus mummified.

PLEISTOCENE.

CAP DE PERA.

Vitrea lentiformis (Kob.).
Otala Balearica (Zieg.).

Helicella Nyelli (Pfr.).
Tudorella ferruginea (Lam.).

HOLOCENE.

MANRESA.

Testacella Maugei, Fér.
Helicella virgata (Mtg.).
H. Itala (Linn.).
Xerophila cespitum (Drap.), var. aff.
introduceta, Bgt.
Helicomanes maritima (Drap.).
Tachea splendida (Drap.).
Helix aspersa, Müll.
Otala vermiculata (Müll.).
O. lactea (Müll.).
O. punctata (Müll.).
Theba Carthusiana (Drap.).
Rumina decollata (Linn.).
Cæcilianella acicula (Müll.).
Pomatias elegans (Müll.).

PORTO PI.

Vitrea sp.
Helicomanes maritima (Drap.).
H. variabilis (Drap.).
Helix aspersa, Müll.
H. Pisana, Müll.
H. sp. (young).
Tachea splendida (Drap.).
Leucochroa cariosula (Mich.).
Otala vermiculata (Müll.).
O. lactea (Müll.).
Trochula terrestris (Ch.).
T. elata (Faure-Biguet).

Theba Carthusiana (Müll.).
Rumina decollata (Linn.).
Folliculus folliculus (Lam.).
Clausilia bidens, Drap.
Tudorella ferruginea (Lam.).

MARINE SHELLS (found mixed with the above).

Columbella rustica, Lam.
Cerithium vulgatum, Brug.
Conus Mediterraneus, Brug.
Tapes decussatus (Linn.).
Diplodonta lupina (Poli).

BELLVER.

Xerocampylæa apicina (Lam.).
Trochula terrestris (Ch.).
Rumina decollata (Linn.).
Folliculus folliculus (Lam.).
Clausilia bidens, Drap.

ALCUDIA.

Vitrea lentiformis (Kob.).
Helicomanes maritima (Drap.).
Trochula elata (Faure-Biguet).

MARINE SHELLS (mixed with the above).

Cerithium vulgatum, Brug.
Osilinus articulatus (Lam.).

Cap de Pera.	Mauresa.	Porto Pi.	Bellver.	Alcudia.	Mauresa.	Porto Pi.	Col.
<i>Testicella Maugei</i> , Fér.	.	.	.	.	.	.	.
<i>Vitrea lentiformis</i> (Kob.)	.	.	.	.	.	.	.
<i>Vitrea</i> sp.	.	.	.	.	.	.	.
<i>Helicella conoidea</i> (Drap.)	.	.	.	.	.	.	.
<i>H. virgata</i> (Mtg.)	.	.	.	.	.	.	.
<i>H. Arigoi</i> (Rossm.)	.	.	.	.	.	.	.
<i>H. Itala</i> (Linn.)	.	.	.	.	.	.	.
<i>H. barbara</i> (Linn.)	.	.	.	.	.	.	.
<i>H. ventricosa</i> (Drap.)	.	.	.	.	.	.	.
<i>Hygromia lanuginosa</i> (Boissy)	.	.	.	.	.	.	.
<i>Otala Balearica</i> (Zieg.)	.	.	.	.	.	.	.
<i>O. vermiculata</i> (Müll.)	.	.	.	.	.	.	.
<i>O. lactea</i> (Müll.)	.	.	.	.	.	.	.
<i>O. punctata</i> (Müll.)	.	.	.	.	.	.	.
<i>Xerophila caespitum</i> (Drap.), var. aff. <i>introduc.</i> a, Böttg.	.	.	.	.	.	.	.
<i>X. lauta</i> (Lowe)	.	.	.	.	.	.	.
<i>Helicomanes variabilis</i> (Drap.)	.	.	.	.	.	.	.
<i>H. maritima</i> (Drap.)	.	.	.	.	.	.	.
<i>Tachea splendida</i> (Drap.)	.	.	.	.	.	.	.
<i>Helix aspersa</i> , Müll.	.	.	.	.	.	.	.
<i>H. Pisana</i> , Müll.	.	.	.	.	.	.	.
<i>Helix</i> , sp. indet.	.	.	.	.	.	.	.
<i>H. Molinæ</i> , Hid.	.	.	.	.	.	.	.
<i>H. Nyelli</i> , Phr.	.	.	.	.	.	.	.
<i>Theba Carthusiana</i> (Drap.)	.	.	.	.	.	.	.
<i>Trochula terrestris</i> (Ol.)	.	.	.	.	.	.	.
<i>T. elata</i> (Faure-Biguet)	.	.	.	.	.	.	.
<i>Leucochroa cariusula</i> (Mich.)	.	.	.	.	.	.	.
<i>Xerocampylea apicina</i> (Lam.)	.	.	.	.	.	.	.
<i>Tudorella ferruginea</i> (Lam.)	.	.	.	.	.	.	.
<i>Rumina decollata</i> (Linn.)	.	.	.	.	.	.	.
<i>Follieulus folliculus</i> (Lam.)	.	.	.	.	.	.	.
<i>Cæcilianella acicula</i> , Müll.	.	.	.	.	.	.	.
<i>Clausilia bidens</i> , Drap.	.	.	.	.	.	.	.
<i>Limnæa acutalis</i> , Morelet (= <i>auricularia</i> , var. ?)	.	.	.	.	.	.	.
<i>Planorbis umbilicatus</i> , Müll.	.	.	.	.	.	.	.
<i>Physa contorta</i> , Michaud	.	.	.	.	.	.	.
<i>Bythinia tentaculata</i> (Linn.)	.	.	.	.	.	.	.
<i>Pomatias elegans</i> (Müll.)	.	.	.	.	.	.	.

RECENT NON-MARINE MOLLUSCA.

MANRESA.

- Helicella Arigoi* (Rossm.) (dwarf form).
Tachea splendida (Drap.).
Pomatias elegans (Müll.).

BELLVER.

- Helicella barbara* (Linn.).
Otala vermiculata (Müll.).
O. punctata (Müll.).
O. lactea (Müll.).
Trochula terrestris (Ch.).
Helix Pisana, Müll.
H. aspersa, Müll.
Theba Carthusiana (Müll.).
Rumina decollata (Linn.).
Clausilia bidens, Drap.

PORTO PI.

- Helicella barbara* (Linn.).
Trochula terrestris (Ch.).
Otala vermiculata (Müll.).
Xerocampylæa apicina (Lam.).
Helix, sp. indet.

ALCUDIA.

- Helicella virgata* (Da C.).
H. ventricosa (Drap.).
H. conoidea (Drap.).
H. Arigoi (Rossm.).
H. barbara, Linn.
Xerophila lauta (Lowe).
Trochula terrestris (Ch.).

MARINE SHELLS FROM ALCUDIA, MALLORCA.

- Patella aspera*, Lam.
Trochus (Osilinus) articulatus, Lam.
T. (Clanculus) Jussieui, Payr.
T. (Gibbula) umbilicaris, L.
T. (Calliostoma) elenchoides, Monts.
T. (Gibbula) ardens (von Salis).
T. (Calliostoma) dubius, Phil.
T. (Calliostoma) Kochi, Polley.
T. (Calliostoma) smaragdinus, Monts.
Phasianella pullus (L.).
Natica intricata, Don, var. *lactea*, Monts.
Truncatella truncatula, Drap. (small var.).
Cerithium vulgatum, Brug.
Murex trunculus, L.
Trophon vaginatus, Cris. & Jan.
Rissoa ventricosa, Desmarest.
Nassa costulata, var. *Renieri*.
Conus Mediterraneus, Brug.
Philine aperta (L.).
Dentalium agile, Sars.
Arca Noæ, L.

- Xerocampylæa apicina* (Lam.).
Helix Pisana, Müll.
Otala punctata (Müll.).
O. vermiculata (Müll.).
Helix Molinæ, Hid.
Rumina decollata (Linn.).
Limnæa acutalis, Morelet,
 = *auricularia*, var. (?).
Planorbis umbilicatus, Müll.
Physa contorta, Michaud.
Bythinia tentaculata (Linn.).

PORTO CHRISTO.

- Helicella ventricosa* (Drap.).
H. conoidea (Drap.).
Helix Nyelli, Pfr.
H. Pisana, Müll.
Helicomanes maritima (Drap.).
Trochula terrestris (Ch.).
Tachea splendida (Drap.).
Rumina decollata (Linn.).
Clausilia bidens, Drap.

SOLLER.

- Helix Nyelli*, Pfr.

PASS OVER THE COL, ABOVE SOLLER.

- Hygromia lanuginosa* (Boissy).
Helicella virgata (Müll.).
H. Arigoi (Rossm.).
Helix Nyelli, Pfr.
H. Molinæ, Hid.

- Glycimeris stellatus* (Lam.).
Pinna nobilis, L.
Ostrea edulis, var. *Boblayi*, Desh.
Spondylus gædaropus, L.
Chama gryphoides (L.).
Pecten varius, L.
P. opercularis, L.
Lima hians (Gmel.).
Lucinopsis undata (Penn.).
Tellina incarnata, L.
Donax venustus, Poli.
D. semistriatus, Poli.
Macra corallina, var. *stultorum*, L.
M. glauca, Born.
Venus gallina, L.
Tapes aureus (Gmel.).
Cardium glaucum, Brug. (= *edule*, var., Röhm. & Kob.).
C. tuberculatum, L.
C. edule, L.
Cardita sulcata, Brug.
C. calyculata (L.).
Anomia ephippium, L.

ON THE OCCURRENCE IN ENGLAND OF *VALVATA MACROSTOMA*,
STEENBUCH.

By A. S. KENNARD, F.G.S., and A. W. STELFOX.

Read 11th March, 1910.

VALVATA MACROSTOMA, Steen., is a well-known and universally recognized species, being known in a living state from Sweden, Norway, Denmark, Northern Germany, Russia, Finland, and Galicia, and in a fossil state from several deposits of Pleistocene age in Germany, and from the Holocene of Denmark. Unlike so many of the Continental 'species' of *Valvata*, it is a species as we understand it, and is quite distinct from the polymorphic *V. piscinalis*. We have always considered it a species which was likely to occur in England, but all our efforts were fruitless until last year, when one of us (A. W. S.) visited the Pevensey Marshes, Sussex, where several examples of *Valvata* were collected at the Eastbourne end of the marsh, which in our opinion are undoubtedly *V. macrostoma*. It may be as well to mention that the object of the visit to Pevensey was to obtain examples of *Planorbis vorticulus*, Troschel, and that the search for this species was unsuccessful at that time. Pevensey was the only locality in these Islands in which *P. vorticulus* had been found living, though it has since been found alive near Whitlingham Station, near Norwich, by one of us (A. S. K.).

On the discovery of these recent examples of *Valvata macrostoma* a further examination was made of all the fossil examples of *Valvata* that we could obtain access to, but no fossil examples were forthcoming. However, on examining a series of Pleistocene mollusca from Clacton, kindly sent by the Rev. R. Ashington Bullen, an undoubted example of *V. macrostoma* was detected.

We have used the specific name *macrostoma* because there is no doubt about this species, but this is not so with regard to *V. depressa*, Pfr., and *V. pulchella*, Studer. We are quite unable to separate *macrostoma* from shells labelled *pulchella* and *depressa* which we have received from Germany. *V. pulchella*, Studer, was never described by Studer, and there is considerable doubt as to what *V. depressa*, Pfr., really is. By some authors it is considered a variety of *piscinalis*. This, at any rate, is certain, that the *V. depressa*, Pfr., of German authors is quite different from that of French authors, just as *Planorbis septemgyratus*, Ross., is unknown to French authorities, who have applied the name to a totally different species, and a similar condition of things exists with regard to *Succinea arenaria*, Bouch. Chant.

Now that *Valvata macrostoma* has been recognized in England it is hoped that further research will discover it in other localities.

DESCRIPTION OF A NEW SPECIES OF *HELICODONTA*
FROM SPAIN.

By G. K. GUDE, F.Z.S.

Read 11th March, 1910.

Two shells received with the name *H. Lusitanica* from Mr. Preston in 1903 were, contrary to my usual practice, incorporated in my collection without verification. Some time ago Colonel G. S. Parry, in dispersing his collection, kindly sent me a large number of shells, amongst them two specimens of the true *H. Lusitanica*, and on comparing them with Mr. Preston's shells it became at once apparent that the latter had been erroneously referred to that species, and as they cannot be identified with any other known form of this genus I venture to describe them as a new species.

Dr. Hidalgo has recorded *H. Lusitanica* from Tabernes de Valldigna,¹ but as it is not clear from his remarks that he had actually seen the specimens it is not impossible that this record is based on wrongly identified shells, and that, therefore, the latter may be conspecific with my own. This distinguished Spanish savant refers to the curious occurrence of this species on two extreme sides of the Iberian Peninsula, and suspects that it will probably be found in intermediate stations.

These observations would, of course, apply equally if my assumption that the specimens to which he refers pertain to the new species be correct. He further records the occurrence of *H. Lusitanica* at Bayona.² This habitat, however, being in such close proximity to some of its Portuguese stations, may be accepted without reservation.

Helicodonta Hispanica, besides being considerably smaller than its congener, differs in the following characters: the whorls do not increase nearly so rapidly and are less inflated, while the last whorl lacks the yellowish border behind the peristome so conspicuous in *H. Lusitanica*; the ribs are finer and less distant, the umbilicus is comparatively narrower and cylindrical, not funiculate; the aperture is much more contracted and of a different shape, being crescentic instead of obovate, while the peristome is much less expanded but more reflexed, and livid instead of white. My specimens of *H. Lusitanica* are possessed of distinct incised spirals on the lower surface, while on the upper side the interstices between the ribs are also spirally striated, but very minutely, features of which no mention is made in any of the published descriptions, and which are lacking in the new species.

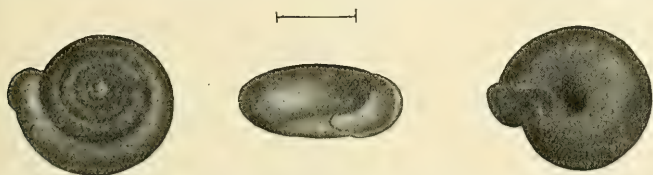
HELICODONTA HISPANICA, n.sp.

Shell moderately umbilicated, lenticular, fulvous brown, rather thin, sub-translucent; the nepionic whorls shining, the remainder dull, finely

¹ Mem. Real. Acad. Ciencias, Madrid, 1890, xv, p. 208.

² Op. cit., p. 255.

closely ribbed, the ribs regularly curved and becoming more distant on the last quarter-whorl. Spire depressed, apex prominent, suture shallow. Whorls $5\frac{1}{2}$, a little rounded above, flattened below, obtusely angulated above the periphery, increasing slowly and regularly, the last ascending a little in front. Aperture crescent-shaped, oblique, margins distant, united by a very thin callus on the parietal wall, which is finely granulated. Peristome curved, scarcely thickened,



reflexed, livid; upper margin a little arcuate at the junction with the shell-wall, curved slightly forward, then suddenly receding, basal nearly straight, columellar receding a little at first, then curved forward, triangularly dilated longitudinally, and impinging upon the umbilicus, which is deep and cylindrical. Diam. maj. 11, min. 10 mm.; alt. 5 mm.

Hab.—Valencia, Spain.

Type in my collection.

THE DISTRIBUTION OF *MARGARITANA MARGARITIFERA*
(LINN.) IN NORTH AMERICA.

By BRYANT WALKER.

Read 8th April, 1910.

PLATE II.

THIS common and well-known species has the most extensive range of any of the Unionidæ. As stated by Simpson (1900, p. 677), it inhabits "all Europe, except the southernmost portion; northern Asia; Japan; northern North America; Iceland. Its southern limit seems to be about north latitude 40°. It appears to be entirely circumboreal, except that, so far as is known, it is missing in the central part of the North American continent".

Wetherby (1881, p. 7) was apparently the first to call attention to the peculiar distribution of the species on this continent, and his suggestion that its absence in central North America was due to its extinction in that region during the Glacial Epoch, and that for some reason it had not, like its associated species, been able to regain its former range upon the retreat of the glacier, has been approved by Simpson (1893, p. 594, and 1896, p. 339), and tentatively, perhaps, by Call (1882, p. 402) and Dall (1905, p. 132).

A recent study of the known distribution of *M. margaritifera* in North America, and the possible causes for its anomalous character, has raised a question as to the sufficiency of Wetherby's supposition, and has suggested that possibly the explanation is to be sought for along an entirely different line of argument.

But before pursuing that subject, it may be well to consider the exact distribution of the species on this continent, so far as it has been made known. The accompanying map (Plate II) shows with substantial accuracy the present range of *M. margaritifera* in North America. The detailed list of the exact localities, from which it has been compiled, will be found at the conclusion of the paper.

On the Pacific coast, it may be said, in general terms, to range, west of the Rocky and Wasatch Mountains, from southern Alaska south to Santa Cruz and Merced Counties, Cal., northern Nevada and Utah, and possibly into Arizona. The most northern locality recorded is that of Dall, at Naha Bay, Alaska, lat. 50° 35' N. The most southern authentic records are the Stanislaus River and Merced Co., Cal. The records from Idaho and Utah are both very considerably north of these Californian localities. It apparently does not occur anywhere in the Colorado basin, unless Call's very doubtful citation be verified. East of the Rocky Mountains, it has only been recorded from the head-waters of the Missouri above the falls (Cooper), and the Gallatin River (Call) in Montana.

This western race of *margaritifera* is peculiar in having the nacre usually of a dull purple colour, and has twice been described as a distinct species, first by Gould in 1850 as *Alasmodon falcata*, and

again by Trask in 1855 as *A. Yubaensis*. Dr. Dall has recently (1905) considered the western form worthy of varietal recognition under Gould's name. The deep purple nacre, however, is not invariably present, and specimens not infrequently occur with the nacre quite as light-coloured as in the typical form. Individual specimens from the eastern states are occasionally quite deeply tinted with purple and salmon colour.

On the Atlantic coast, the most northern record is from Labrador (Packard), but this is questioned by Whiteaves. It is found in Newfoundland (Johnson and Marshall); Anticosti (Johnson); New Brunswick (Matthew and Walker); Nova Scotia (Jones); in the northerly tributaries of the St. Lawrence west to the St. Charles River at Quebec (Litchford); in Maine (Lermond); Vermont (Adams, Davis, and Walker); Massachusetts (Call, Davis, and Walker); Connecticut (Davis and Walker); Rhode Island (Carpenter); Eastern New York (Lewis, De Kay, Marshall, and Walker); and in Chester Co. (Hartman and Minchner), Delaware Co. (Lea), and Schuylkill Co., Pennsylvania (Connor and Ortmann).

The Delaware Co., Pa., locality is the most southern yet recorded on the Atlantic coast. It has not been listed from New Jersey or Delaware so far as I have been able to ascertain.

In New York, where it attains its extreme eastern range, it is recorded from Oneida Co. (De Kay and Marshall), and Fox Creek, Lewis Co., a tributary of Oneida Lake (Walker).

In general, therefore, it may be said that on the Pacific coast its range is limited on the east by the Rocky Mountains, and on the Atlantic coast it is confined to the region east of the Appalachian Mountains. In both instances, however, it has, in occasional instances, obtained a foothold in the interior beyond the mountains, but in such cases its range is extremely limited. In the United States, there is no authentic record of its occurrence between Lewis and Oneida Counties, N.Y., and the Falls of the Missouri in Montana. In British America, with a single exception, it has not been recorded at all from the vast region extending from the Rocky Mountains east to Quebec. The single exception above mentioned from Central British America is that of Dall (1905), who records the typical (eastern) form from the lower Saskatchewan near Lake Winnipeg.

In considering the possible causes of this peculiar distribution of the species, it is necessary to take into consideration not only its general distribution at the present time, but also the geologic changes, which in past ages have affected the configuration of the continents as they now exist, and which may have played an important part in permitting or preventing the migration of the species in different directions from the primitive place of origination. In the first place, the genus *Margaritana*, as limited by Simpson, is evidently a very ancient one. This is shown not only by the enormous range of the typical species (*margaritifera*), but also by the equally remarkable discontinuity of the ranges of the six species included in the genus.

As already stated, *M. margaritifera* is circumpolar, with the apparent exception of the central region of British North America.

M. crassa is restricted to South Europe, where it apparently replaces *margaritifera* and extends "possibly into Asia Minor, and south-west Siberia" (Simpson, 1900). *M. Laosensis* is known only from Cambodia and Burmah. *M. Hembeli* is confined to the gulf drainage of southern Louisiana and Alabama. *M. monodonta* is found only in the central United States, where it inhabits the Ohio, Tennessee, and Cumberland river systems and ranges west to Illinois, eastern Iowa, and possibly Nebraska (Simpson, 1900). The type and only known specimen of *M. decumbens* came from Alabama, but the exact locality is unknown. It must be very rare, as the exhaustive collections made in that state during the last five years by Mr. H. H. Smith have failed to rediscover it. The recorded ranges of the several American species are indicated on the map (Plate II):

M. Hembeli is the most aberrant member of the group, and differs from all the other species by the plicate dorsal area. Too little is known of *M. decumbens* to base an opinion on. Dr. Lea compares it with one of the many forms of *Unio complanatus*, Dill., and if it came from the Atlantic faunal area of Alabama the comparison is, perhaps, suggestive. If, however, it came from the Alabama drainage system, it is possible that it may prove to be an offshoot from the *monodonta* stock of the Tennessee drainage, modified specifically in the same way that so many of the species of that system have been since it was separated from its ancient connexion with the Tennessee. It is possible, however, that both these species are of an entirely different line of descent, and a more extended knowledge of their anatomy may necessitate their removal from the genus.

The remaining four species are essentially homogeneous. *Margaritifera* and *crassa* are closely related, and *Laosensis* and *monodonta* stand in about the same relation to *margaritifera*. The range of the two latter species is of interest in connexion with the range of the *margaritifera* and not without importance.

Margaritifera itself is a very ancient species, which, through an enormous extent of time, during which it has wandered nearly, if not quite, around the globe, has preserved its peculiar characters and specific identity to a remarkable degree. The essential similarity of the species as it exists at the present time on the different continents is very remarkable, and indicates that its persistent specific characters were well established before its long migration was begun. As North America has been permanently separated from Asia and Europe since the close of the Tertiary period, and the progress of the species in its long journey must have necessarily been slow, there would seem to be no doubt but that the evolution of the species must have long antedated that period, and quite possibly may go back even to Cretaceous times.

Where the species did originate is by no means clear. It must have been either in Europe, Asia, or North America. That it is an immigrant into Europe is generally conceded. Dr. Scharff, in his recent work on European Animals (1907, p. 34), expresses the opinion that it reached Europe via Greenland and Iceland. If so, the inference would be that it originated in North America, and from

there spread east into Europe and west into Asia. But there are several objections to that theory.

There is no doubt but that the characteristic Unione fauna of North America is descended from the Upper Cretaceous species, which then lived "in the region now included in the states of Colorado, Utah, Wyoming, South Dakota, and Montana, and in the Canadian territories of Alberta, Assiniboia, and Saskatchewan" (see White, 1905, p. 86). If *M. margaritifera* originated in central North America during the extraordinary development which took place in the Unionidæ of that time, it must have travelled nearly around the globe, across Europe and Asia, and over the Behring bridge in order to have attained its present foothold on the Pacific coast, *because it could not have reached there in any other way*.

During the Upper Cretaceous period, this portion of North America was separated from the present Pacific region by an arm of the sea which extended from the Gulf of Mexico to the Arctic Ocean. This insurmountable barrier was at the end of the Cretaceous and in the beginning of the Tertiary replaced by another, owing to the elevation of the Rocky Mountains. And as Ortmann well states (1902, p. 354), "this barrier was probably emphasized by the development of desert conditions, in and at the foot of this mountain range." This barrier was sufficient to prevent the crayfish, which reached the Pacific coast from Asia during this period, from passing into eastern North America (Ortmann, 1902, p. 356), and according to Pilsbry (1904, p. xliii) similarly restricted the range of the Asiatic Helicidæ, which came in at the same time. So too with the Unionidæ, this barrier, first of sea, and later of mountain, has unquestionably been an absolute one to the extension of the fauna, either to the east or to the west.

The relations of the present Unione faunas east and west of the Rocky Mountains at the present time are very significant in this connexion. West of the mountains the fauna, meagre in species, is represented by only three genera—*Margaritana*, *Anodonta*, and *Gonidea*. The latter is endemic and is confined to that area. The single species of *Margaritana* is the one under discussion. The *Anodontas* are all of a common type, evidently of Asiatic derivation, and, in some of its phases, so similar to the common European species, *A. cygnea*, that an eminent conchologist in this country has questioned their specific distinction from that species (see Stearns, 1882, p. 17).

As in the Helicidæ, so in the Unionidæ, the relations of the Pacific fauna are wholly with the Old World, and are no doubt the results of early immigrations from Asia (see Pilsbry, 1904, p. xliii). The *Anodontas* have never succeeded in passing the mountains. And the only known instance of the *Margaritana* doing so is the occurrence in the head-waters of the Missouri in Montana. (The Saskatchewan locality may, perhaps, be another instance.) That this is, probably, of comparatively recent date, is shown by the fact that it has not as yet extended its range any further east. This colony "may have been captured with streams by orographic changes or transported in the glochidium stage attached to fishes" (Dall, 1905). The *Margaritana*, moreover, preferably inhabits rapidly running water,

and on both the east and west coasts is found high up in mountain streams, while the *Anodontas*, on the contrary, are essentially inhabitants of lakes and the deeper waters of slow-moving rivers, a fact which may explain the 'capture' of the *Margaritanas* of the Missouri, in which the *Anodontas* were not involved. On the other hand, not a single one of the several hundred species of the *Unione* fauna of the Mississippi and eastern North America, which no doubt are descended from the Cretaceous *Unionidæ* of the western states, has ever succeeded in passing over or around the mountains and obtaining a foothold on the Pacific coast or in Asia.

If it were true that the *Margaritanas* of the Pacific coast of North America and Asia were the descendants of an early migration to the north-west from central North America, it is certainly very remarkable that the species was not accompanied by any of the species which must have been associated with it in Cretaceous or early Tertiary times. But there is not the slightest evidence of anything of the kind. And in view of this fact, as well as the acknowledged relations of the Pacific coast fauna with that of north-eastern Asia, it would seem to be certain that no such migration ever did occur, and that the present *Margaritanas* of the Pacific coast are derived from Asiatic sources.

If this be conceded, then, if *Margaritana* originated in North America, its occurrence in the Old World must be accounted for by a north-easterly migration from central North America across the Greenland bridge into Europe, and from there entirely across Europe and Asia and, via the Behring bridge, into California. The first part of the hypothesis would accord with Dr. Scharff's theory, but not the necessary extension of the route to account for the occurrence of the species in eastern Asia and western North America. This he would apparently attribute to a north-western migration from North America. But this we have shown is untenable.

There is apparently little doubt but that, following the manifold mutations of the *Unionidæ* in the Upper Cretaceous, as Simpson (1895, pp. 336-7) has already pointed out, there was an extensive dispersal of the *Unionidæ* in two directions—eastward through British America and the northern United States (in the early Tertiary, the Gulf of Mexico extended north above the present junction of the Ohio and Mississippi Rivers) and south into Mexico. It was with the northern migration, if at all, that the original *Margaritanas* reached the Atlantic coast and Greenland from the region of the Mississippi. It seems to be clear that the migration did extend to the Atlantic coast from the close relationship that exists between many of the existing species of the Atlantic drainage with those of the Mississippi system.

The exact relation, as to specific identity, between the pre-Glacial fauna of eastern North America and that which now exists is not known. Except as scattering fragments may have survived in favourable localities along the coast, it was entirely exterminated north of the Ohio by the ice of the Glacial Epoch. From that time the Atlantic and Mississippi faunas as a whole have been entirely

separated and have developed in different, though in many cases along analogous, lines.

There is reason to believe that the pre-Glacial northern migration consisted of comparatively few specific types, and that the peculiar genera characteristic of the Mississippi fauna, many of which have the head-waters of the Tennessee system as their centre of distribution, originated from another migration along an entirely different route. But be that as it may, it is significant that nearly every species of the comparatively small northern Atlantic fauna has its analogous species of general distribution in the present fauna of the northern states west of the Appalachian mountains, viz.—

ATLANTIC.

Lampsilis radiata.
L. cariosa.
L. nasuta.
Unio complanatus.
Alasmodonta heterodon.
Strophitus undulatus.

MISSISSIPPI.

Lampsilis luteola.
L. ventricosa.
L. subrostrata.
Unio gibbosus.
Alasmodonta calceola.
Strophitus edentulus.

It may perhaps be claimed that *M. margaritifera* and *M. monodonta* should be included in the above list, but the latter is not a species of general distribution in the north central states as the others are, and its occurrence in the Ohio and Tennessee systems can apparently be better explained in another way. Putting that species aside temporarily, it is certainly remarkable that if *M. margaritifera* originated in central North America in pre-Glacial times, and took part in the pre-Glacial migration above indicated, it did not leave any traces of its former existence in the Mississippi Valley. As already remarked, wherever it did originate it has extended nearly all round the world, and during all the enormous period required for that dispersal and under all the varied conditions of environment to which it has been subjected, it has always and everywhere maintained its specific identity, or varied within comparatively narrow limits. In view of these unquestionable facts, it would seem improbable that it could have been a member of the pre-Glacial Mississippi fauna, and yet nowhere in the Mississippi Valley have left any remnant to preserve a record of its former occurrence in that region. The theory of the trans-Mississippian origin and subsequent extermination by the ice-cap involves the necessity of its complete emigration from the entire Mississippi region south of the glaciated area, before the beginning of the Glacial Period, a most violent assumption in view of the fact that it is not true of any other species belonging to the pre-Glacial fauna.

Taking into consideration, therefore, the apparent impossibility that there could have been any extension of the species to the west or north-west, and the improbability that a pre-Glacial migration from the trans-Mississippi states to the north-east could have taken place without leaving some trace somewhere in the vast extent of territory traversed, as apparently all the other specific types involved in that migration have done, and realizing that such a hypothesis involves a migration eastward around nearly the entire globe from central

North America to California, it would certainly seem highly improbable, and any other theory which offers a reasonable explanation for the present distribution of the species would be preferable.

If, then, the American origin of the *Margaritana* is improbable, there only remains the possibility that it originated in Asia. If such an origin can be assumed, it certainly gives a much more reasonable theory for the dispersal of the species than that of an American centre of distribution. It is practically certain the Pacific coast race of the species was derived from an Asiatic immigration. So that portion of the problem is satisfactorily disposed of. An Asiatic centre of distribution with a western migration into Europe would be quite in accord with the recognized theories in regard to a very large part of the present European fauna. In this connexion it is to be noted that both Simpson (1900) and Dall (1905) give a much more extensive range toward the west in northern Asia than is shown by Scharff in his map in 1907 (loc. cit., p. 35). This is probably due to the inclusion in the synonymy of *margaritifera* of several North Asian forms which have been described as distinct species. This granted, a western extension from European land across the Greenland bridge into eastern North America would be quite as feasible as a corresponding migration at the same time in the other direction. There is, then, no insurmountable objection to such a theory. It must be confessed, however, that the direct evidence in favour of an Asiatic origin of *Margaritana* is not as satisfactory as it perhaps might be, if we knew more of the palæontological history of the Unionidæ in that country and of the exact distribution of the present fauna.

Simpson (1896, pp. 334-6) has called attention to the remarkable similarity in many respects existing between the Unione fauna of North America, and the present fauna of south-eastern Asia and the Tertiary fauna of both Europe and Asia, and thus states his conclusion: "Whether the Naiades originated in North America or in the Old World is not known. At any rate, I do not think that any careful student can examine a good series of species from the Oriental region without being convinced that the Unione fauna of that area is somewhat closely related to that of the Laramie Beds and the Mississippi Valley, and a conclusion seems reasonable that a migration took place perhaps during or shortly after the Laramie epoch over an old, now submerged, land-way either from Asia to North America, or *vice versa*. It is, I believe, more probable that this fauna developed in the western continent than the eastern, for, as we have seen, a few prophetic types of it appeared in the North American Jurassic, while the earliest recorded existence in the Old World of species, which seem intimately related to it, is in the later Cretaceous or earlier Tertiary. While some eight or ten groups of Unios and Anodontas, now living in the Oriental region, bear such a strong resemblance to similar assemblages in the United States that, at first sight, they seem to be the same, I believe every one of them to be distinct, and it seems probable, when it is taken into consideration how slowly the Naiades change and the fact that the forms of the Laramie groups have scarcely altered specifically in our own

country, that if such migration and separation took place it occurred a long time ago."

In this connexion, it is to be noted, as Simpson has already pointed out, that the southern migration of the Cretaceous fauna into Mexico and Central America has resulted in the evolution of several distinct groups in that region, which are not represented in the present Mississippi fauna, and as he states, "These older Central American faunal groups bore about the same relation to those of the Mississippi Valley as do many of those of the Oriental region." This would suggest the possibility that if the Asiatic fauna was derived from the Cretaceous fauna of North America, it was a migration from the ancient fauna of Mexico and Central America rather than from that portion of the Cretaceous fauna that remained in the north, to become the progenitors of the present Mississippi fauna. In view of the fact that the way was clear, from the Upper Cretaceous to the later Tertiary, for the Asiatic crayfish and *Helices* to pass down the Pacific coast into Mexico, it would seem possible at least for the ancient Unionidæ of Mexico to find their way into Asia by the same route. This would supply the necessary link between the two faunas, and would not in the least militate against the argument already advanced as to the improbability of any migration from central North America into Asia. In this connexion the following extract from a recent letter from Mr. Harold Hannibal, of Stanford University, Cal., is of interest: "I have been working on the vertical distribution of this species myself, and can give the following, which you are welcome to use: *Unio* (*Margaritana*) *margaritifera* immigrated from Eurasia in the earliest Quaternary. It first appears on the west coast in the Upper Bonnevillie, which should be correlated with the later glacial epoch. A very closely related species occurs in the Tejon formation (Eocene) at Tesla, Cal. There are practically no distinguishing characters, except the latter is a survivor of the occurrence of this sub-genus, *Quadrula* and a number of other genera from the Cretaceous and Laramie, while the former is an immigrant. That this species migrated to Europe during the Eocene, survived there, and migrated back in the Quaternary, is possible, but to avoid confusion I will name it something else."

The difficulties suggested by this latter theory might be avoided by the assumption that this Eocene *Margaritana* was a remnant of the earliest invasion of this continent by this species from Asia. The association of *Quadrula* with it is of great interest, and may determine which hypothesis is correct. It is to be noted, however, that the theory that this Eocene *Margaritana* was of American origin, involves the assumption that the species or its prototype originated on this continent, and had practically attained its specific characters before it passed over into Asia. There is, as yet, no evidence except this of that fact, and while its occurrence in the Eocene with *Quadrula* would seem to argue in favour of the Mexican-Asian migration above suggested, on the other hand the fact that neither it nor any congeneric form is found in the present fauna

of Mexico and Central America, would seem to be an argument against that view. But however that may be, in the absence of any direct evidence on the subject, it might be said that it is quite as possible that the genus sprang from the series of mutations involved in the evolutionary history of the later Cretaceous Unione fauna of Europe and Asia, which from some cause became extinct in Europe, but which, under more favourable conditions of environment, survived in Asia and gave rise to the present fauna of that country, as that it originated in the Cretaceous mutations of the North American fauna. The existence of a similar species of the genus (*M. Laosensis*) at the present time in Siam and Burmah, would also seem to be of considerable significance as bearing on the probability of an Asiatic origin of the genus. In view of the remarkable tenacity of *M. margaritifera* in retaining its specific characteristics, it is evident that the separation of the Siamese race must have taken place at a remote period.

The conclusion of the whole matter, so far as the question of the origin of the genus is concerned, would, therefore, seem to be this: There is no direct evidence available at the present proving either that it was American or Asiatic. So that, for the time being, the decision must be based upon such legitimate deductions as can be drawn from the known facts of present distribution, taken in connexion with such recognized palæogeographic changes in continental areas as would seem to substantiate the theory proposed. If an Asiatic centre of dispersal be assumed, for purposes of argument, and a subsequent western migration through northern Europe and across the Greenland bridge in Miocene or early Pliocene times (Scharff, loc. cit., p. 123), there is at once at hand a reasonable explanation for the peculiar distribution of the species in eastern North America. Whether this intercontinental migration was eastward or westward, it must have taken place at this period. Not only it could not have occurred later, but it must have been sufficiently prior to the Glacial Period to allow the species to proceed far enough south along the American coast to allow a remnant to survive the ice-sheet, and to serve as a new centre of dispersal upon its retirement.

Whether this original immigration, if it came from the east, succeeded in reaching central British America, is not known. If it did, it was no doubt wholly exterminated by the ice in that region. That it was entirely wiped out at this time by the glaciers along the sea-coast is not so clear. There is apparently reason to believe that a considerable portion of the fauna survived through the Glacial Period as far north as Greenland (Scharff, loc. cit., p. 123). And the fact that *M. margaritifera* is at the present time found on both Newfoundland and Anticosti would seem to show that on both of these islands it was, by favourable environmental conditions, enabled to survive during that period. And it is quite possible that similar conditions may have enabled isolated colonies to survive on the coast of the mainland. There is also reason to believe that a similar survival of the fauna in favourable locations during the Glacial Period may have occurred on the Pacific coast (see

Adams, 1905, pp. 56-61). But however that may be, after the retreat of the ice, the surviving colonies of the species gradually spread out and re-peopled the post-Glacial drainage systems, and finally attained the distribution of the present time.

The western extent of the present range of the species has been no doubt determined by two main factors: first, suitable conditions of environment; and second, opportunity of access by water toward the west from the several points of post-Glacial dispersal.

The first of these has been apparently the preponderating one in the case of the species under discussion, although it must be confessed that we do not know just what these are. The fact is, however, that barring the one citation from the Saskatchewan (to be considered later) there is no evidence that since Glacial times it has succeeded in extending its range further west through Canada than the neighbourhood of Quebec.

That its range further westward has not been for lack of opportunity is shown by the fact that characteristic species of the Atlantic fauna, such as *Unio complanatus*, Dill., and *Anodonta marginata*, Say, which no doubt shared with *Margaritana* the vicissitudes of the Glacial Period, and in Post-Glacial times presumably started from practically the same centres of dispersal, have succeeded in obtaining a wide range to the west and north. Thus *A. marginata* is an abundant species throughout the whole of the St. Lawrence drainage area from Anticosti Island to Lake Superior, and north to Keewatin and Hudson Bay. *U. complanatus*, though found in but few of the southern tributaries of the Great Lakes between Ontario and Superior, is the most abundant Unionid in the Lake Superior basin, from which it ranges north to the Saskatchewan.

In this connexion the distribution of the well-known *A. cataracta*, Say (*fluviatilis*, Dill.), is of interest and significance. This species is closely related to the European *A. cygnea*, and is the east coast analogue of the west coast species of the same group. There is reason to believe that it was a co-immigrant with *M. margaritifera* to the east coast of North America. It is probable, too, that the common European snail, *Helix hortensis*, Müll., was also a participant in the same migration (see Johnson, 1906, p. 80). It has, however, since its arrival in this continent become much more modified from the ancestral type than the west coast race and has better claims to specific recognition. The range of both races on the two coasts is remarkably similar. Both have extended further south than *Margaritana*, but both have substantially the same inland range as that species. Thus *cataracta* is found in the streams of the Atlantic drainage from North Carolina, north to the St. Lawrence. In the St. Lawrence drainage it does not apparently occur west of Ottawa, Ont., and Buffalo, N.Y. It has been cited from some of the northern tributaries of Lake Huron and Lake Superior, but Simpson questions these, and it is quite probable that the citations are based on forms of *A. marginata*, which does occur in those districts. But even if they be correct, it is clear that the western range of the species is very much more restricted than either *A. marginata* or *U. complanatus*.

Now, it would seem to be evident that, if the latter two species have been able since the close of the Glacial Period to obtain such a wide range to the north-west, *M. margaritifera* and *A. cataracta*, which have apparently always been associated with them since pre-Glacial times, could have accompanied them in this western migration had the environmental conditions of the more western waters been favourable to their existence.

There is apparently no satisfactory explanation to be offered as to why the western region does not offer a suitable environment, but such would seem to be the fact. Under the assumption, therefore, that the east coast *Margaritana* is an immigrant from Europe, it is clear that, if in pre-Glacial times it succeeded in reaching central British America, it was wholly exterminated in that region by the ice, and that since the close of the Glacial Period it has not succeeded in getting into that region, although other associated species have been amply able to do so.

But did it succeed in getting into central British America in pre-Glacial times? There is no direct evidence, so far as I know, showing just what the Unione fauna in that region was at that time. But as we know that the Atlantic drainage was prior to the Glacial Period peopled by an immigration from the then fauna of the Mississippi Valley through that region, it is to be presumed that the fauna was composed of substantially the same species (or their prototypes) that now are found in the Atlantic drainage. The climatic conditions of the region at that time were presumptively favourable to the existence of such a fauna. They certainly were at the time when the eastern migration took place, and there is no reason to predicate any substantial change in these conditions until the commencement of the Glacial Period. That being so, it is a fair inference that the climate of the region at that time was not greatly different from what it is at the present time. It is also evident that if at that time the western Unionidæ were able to make their way to the Atlantic coast there was no reason, so far as opportunity of access is concerned, why *Margaritana*, which at that period had arrived on the coast, should not have been able to pass westward along the same system of waterways, unless prevented by the same unfavourable conditions of local environment which have apparently since post-Glacial times restricted its range to the westward. It is certainly a fair presumption that the species at that time was subject to the same limitations that it evidently is at present. There is indeed no evidence that it ever did reach that region. And between the two presumptions that doubtless is the more reasonable which is in accord with the known facts affecting the inland range of the species, at the present time.

It might be argued that if *Margaritana* was a member of the pre-Glacial fauna of central British America, it is strange that it did not participate in the retreat southward of the fauna upon the advent of the Glacial conditions, and from the surviving remnant of that migration, after the retreat of the ice, spread out again to the north and reoccupy the region from which it had been driven.

While there was, no doubt, such a recession of the terrestrial molluscan fauna southward at that time; and that the "survivors crowded with the boreal forms in a band along the states bordering the glaciated area" (Pilsbry, 1906, p. 531), there is no evidence that there was any such survival of the pre-Glacial *Unione* fauna of that region. Indeed, the probability is all the other way, as it was wholly impossible for the fluviatile fauna to escape by migrating to the south unless the existing systems of drainage afforded the necessary water communications for them to reach the unglaciated area in the south. There is no evidence that any such waterways were then in existence. And a consideration of the present fauna shows that it is wholly unlikely. The eastern migration of the primitive Mississippi fauna was undoubtedly a very ancient one, and it is probable that the differentiation of the species taking part in it into the distinct races now existing on either side of the Appalachian Mountains took place before the advent of the Glacial Period. This is apparently shown by the fact that the fossil relics of the Interglacial *Unione* invasion of Canada are specifically identical with the species now living in the Ohio Valley (see Simpson, 1893, p. 592). This would certainly seem to show that there has been no radical change in the character of the fauna since Glacial times.

The entire area now comprised within the St. Lawrence drainage system was within the glaciated area. In order, therefore, for any of the pre-Glacial *Unione* inhabitants of that region to have escaped extermination by the ice, they must have succeeded in escaping from that region and in obtaining a refuge in the Ohio and Mississippi Valleys. If *Margaritana* and its pre-Glacial associated species, such as *U. complanatus*, *A. marginata*, and *A. cataracta*, ever succeeded in effecting such an escape, it is certainly very remarkable that not a single one of them has left any survivors in the Ohio and Mississippi Valleys to bear witness of their ancient place of refuge. And not only that, if there were any survivors left south of the ice-cap, why did they not accompany the then existing species of those rivers in their invasion of the glaciated area upon the retreat of the ice? The present fauna of the upper Great Lakes and central British America is clearly the result of two distinct immigrations, one from the south of the dominant species of the Ohio and Mississippi faunas, and the other from the east of the more vigorous species of the Atlantic fauna (see Walker, 1898). It would seem to be certain, therefore, that the pre-Glacial *Unione* fauna of the glaciated area was wholly exterminated.

The occurrence of *Margaritana monodonta*, Say, west of the Appalachian Mountains, occupying a territory in which *M. margaritifera* is wholly unknown, is of great interest. It is quite similar apparently in general appearance to the Siamese *M. Laosensis*, and the relation of both species of *margaritifera* would appear to be very much the same. It is probable that both are ancient offshoots from the more ancient *margaritifera* stock.

The distribution of *M. monodonta* is comparatively a limited one. In the Ohio its most eastern record is at Cincinnati (Sterki, 1907,

p. 393). It does not appear to range as far east as western Pennsylvania (Ortmann, 1909). In Indiana it is cited by Call (1900, p. 526) and Daniels (1903, p. 650) from the Ohio and Wabash, and from there ranges west through Illinois (Baker, 1906, p. 76). into the Mississippi drainage of eastern Iowa (Keyes, 1889, p. 19). It has been listed from the Elkhorn and Blue Rivers in Nebraska by Aughey (1877, p. 703), but these records, like many others of that author, require verification. In the Mississippi it is recorded by Baker from Adams County, Illinois, which is the extreme south-westerly record. Its range northward in that river is apparently a limited one, as it is not recorded from Wisconsin by Chadwick (1906), nor from Minnesota by Grant (1885 and 1887). It is found also in the Tennessee drainage system at Knoxville, Tenn., in the Holston and Little Rivers, and in the Tennessee River at Florence, Alabama (Walker). It has not yet, however, been recorded from the head-waters of the Tennessee system. Its distribution is apparently very local and discontinuous, as shown by the chart (Plate II). In the absence of any record of its occurrence in the south and west beyond the points mentioned, the inference would be that its original point of dispersal was in the east, and that it had migrated westward by two routes, one down the Ohio and thence into the Mississippi Valley, and the other down the Tennessee from its tributaries or head-waters. That it reached its present range by a migration from the south-west is, in view of the known facts of its present distribution, quite improbable.

On the other hand, that it was originally an immigrant from the head-waters of the Atlantic drainage into those of the Ohio and Tennessee is most probable. While it has not as yet been recorded from the head-waters of those river systems, that is no reason why it may not yet be discovered in both, for as already remarked, the species is remarkably local in its distribution, and, even if no longer resident, it may not have formerly lived there. The head-waters of the eastern and western drainage systems of the Appalachian slopes are not so widely separated that there has not been in past ages stream transference from one system to the other, with the consequent introduction of the fauna from one system into the other. This is shown by the occurrence of *Anculosa*, a characteristic western genus, in the Atlantic drainage (see Pilsbry, 1894, p. 26). The presence of *Quadrula* and *Pleurobema*, two of the most prevalent genera of the Tennessee system, in the Atlantic drainage of Virginia and North Carolina points unmistakably to the same fact. And if these distinctly western forms, by means of ancient orographic changes, were enabled to cross the divide and obtain a foothold in the Atlantic rivers, there is no reason why in the same way the molluscan fauna of the early eastern streams should not at some time have succeeded in obtaining access to the head-waters of the western drainage system. That the migration was a very ancient one is shown by the specific differentiation that has taken place in the species thus transferred from one area into the other. It may be fairly concluded, therefore, that the presence of *Margaritana* in the

Ohio and Tennessee systems is rather the result of an ancient migration from the north-east than one from the south-west.

The occurrence of *M. margaritifera* in the lower Saskatchewan near Lake Winnipeg, quoted by Dall (1905), is certainly remarkable, and from our present knowledge difficult of explanation. According to Dall, the specimens are of the eastern white-nacred (typical) race. It seems quite impossible that this colony could be a survivor from any pre-Glacial fauna. That its present range in that region is a very limited one is apparently shown by the fact that the very considerable collecting in that region done by the Canadian naturalists in recent years, and reported upon from time to time by Whiteaves, has so far failed to discover it. Nor is there any record of its occurrence in the Hudson Bay system to the south or east. If the colony was of the purple-nacred western race, its occurrence in the Saskatchewan might be accounted for in the same way, that it is probable it obtained a foothold in the head-waters of the Missouri. But there is as yet no record of its presence in any of the headwaters of the Saskatchewan or its tributaries. In view of the fact, however, that the western race not infrequently has the nacre quite as light-coloured as that of the eastern or typical form, there would seem to be no intrinsic improbability in the western derivation of the Saskatchewan colony. It is possible, of course, that its occurrence in this particular locality is one of those cases of sporadic colonization (possibly by bird transportation) that occasionally occur to puzzle the zoo-geographer. The discovery of the *Planorbis bicarinatus*, Say, at Antioch, California, many years ago is a case in point (see Walker, 1909, p. 23). But, of course, that is, at the best, a mere possibility. It is very desirable that its occurrence in the Saskatchewan should be verified, and if rediscovered, that the extent of its range should be accurately determined with the purpose of finding the true explanation for its presence there, and until that is done there is very little that can be said that would be of any value.

In conclusion, it is submitted that from all the data accessible at the present time the following inferences as to the distribution of *M. margaritifera* may fairly be deduced:—

1. That it is not probable that the species originated in North America.
2. That it is probable that it did originate in Asia.
3. That its presence on the western coast of North America is due to a migration in Miocene or early Pliocene times from Asia over the Behring bridge, or perhaps even earlier.
4. That its occurrence on the east coast of North America is best explained by a similar immigration from Europe over the Greenland bridge.
5. That there is no evidence to show that it was an inhabitant of central British America in pre-Glacial times.
6. That there is reason to believe that the causes which, since the Glacial Epoch, have prevented it from invading that region were equally efficacious in restricting its western range before that time, and that it consequently was not exterminated in that region by the Glacial ice-cap, for the reason that it was not there to be exterminated.

II. LOCAL DISTRIBUTION IN NORTH AMERICA.

EAST COAST.

Labrador (Packard).—This citation is questioned by Whiteaves (1901) on the ground that it was based on hearsay only.

Newfoundland.—Newfoundland (Marshall); St. Barbes; Birchy Brook, near Sandy Pond (Coll. Bost. Soc. Nat. Hist., *teste* C. W. Johnson in lit.).

Anticosti Island.—Fox River (Coll. B.S.N.H., *teste* C. W. Johnson).

Quebec.—Green and Rimouski Rivers; Lake St. John; the Metapedia Lakes; River St. Charles near Quebec City and Assumption River near Rawdon; Lac de la Ferme, Rivière de Loup (*en haut*), and Romaine River (Whiteaves). "*M. margaritifera* occurs in many, probably in all the streams flowing southward to the St. Lawrence from far out in the Gulf, westward to the St. Charles at the City of Quebec. It may be found in the north shore streams west of Quebec, but I have no knowledge that it so occurs.

"The streams along the south shore of the St. Lawrence seem to be barren of this shell, but that is only, I think, because they have not been well searched. I feel sure I can find it in the proper season near Cacouna or Rivière de Loup (*en bas*) and along the north shore of New Brunswick, and in the streams running into the Bay of Chaleurs" (F. R. Latchford in lit.).

New Brunswick.—Tributary of Loch Lomond (Walker). "A frequent species in swiftly running streams in this province" (G. F. Matthew in lit.).

Nova Scotia.—"Fresh-water lakes and streams" (Jones).

Maine.—Portland (Chickering); Aroostook River (Nylander, Davis, Walker); Red Brook, Scarboro; Payson's Brook, North Warren; Oyster River, East Warren; Hebron (Davis); Madawaska River (Walker); "all over the state in rocky and muddy brooks" (Lermond).

Vermont.—Burlington; Middlebury (Adams); Winooski River (Davis, Walker); Wallingford, Ct. or Vt. (Davis); Connecticut River, Hartland (Marshall).

Massachusetts.—Lunenburg (Davis, Walker); Lansfield; Springfield; Ware (Davis); Haydenville (Davis, Marshall); "found in most running streams in the interior. I have never found it near the seaboard" (Gould).

Rhode Island.—Roaring Brook, Exeter (Carpenter, Davis).

Connecticut.—Trumbull River (Linsley); Pequabuck River, Bristol (Davis); Bissel's Brook, Granby; Waterford (Davis, Walker); West Granby (Walker).

New York.—"Rockland County; Champlain; Oneida and many other localities" (De Kay); Oneida Lake (Beauchamp); Lake Champlain; tributaries of Mohawk, Oneida County (Marshall); Fish Creek, Lewis Co. (Walker); Hudson River (Jay).

Pennsylvania.—White Clay Creek, Chester Co. (Hartman and Michener); Crum Creek, Delaware Co.; Middle Pennsylvania (Lea); Still Creek, Quakake, Schuylkill Co. (Connor, Ortmann).

Doubtful and erroneous citations:—

New York.—Lake Erie, "Jay" (Letson). This citation is an error on the part of the author of the "Check List". The reference given is to Jay's Catalogue of 1852, p. 69. There is no reference to this species on p. 69 and no citation of it from Lake Erie elsewhere. *Alasmidonta marginata*, Say, from Lake Erie, is, however, listed on p. 69, so that the error is, no doubt, one of transcription.

Illinois.—Joliet (Marshall). This citation is given on the authority of Mr. A. A. Hinkley, of Du Bois, Ill. Mr. Hinkley in a recent letter informs me that the citation was an error, that the species was really *monodonta*, Say.

Illinois River (Baker). Mr. Baker informs me that this citation is based on an undoubted specimen of *M. margaritifera*, so labelled, in the Calkin collection now in the Museum of the Chicago Academy of Sciences; that it has never been found in that region by any other collector; that "a number of Calkin's shells are inaccurate as to locality, and it is probably another case of the mixing of shells". I have no doubt but that this is correct, as I have in my own collection a specimen of this species from the collection of the late J. M. Delaney, New York, which is labelled "Ohio River, Trumbull, Ohio". This place is in Ashtabula County, a few miles south of Lake Erie and in the St. Lawrence drainage, and many miles from the Ohio River. The specimen is a large one, and very similar to the large form from the Winooski River, Vt. The locality is given on the label as an impossible one, and there can be no question but this again is a "case of mixing shells".

WEST COAST.

Alaska.—Naha Bay, lat. 55° 35' North (Dall).

British Columbia.—Small streams entering Malaspina Strait; Kakwous Lake, the source of the Bonaparte River, alt. 4000 feet; Campbell's Creek, Douglas (Whiteaves); Victoria; Nawaimo; Vancouver Island; Fraser River, Kakwous Lake, and streams in lat. 50 degrees (Dall); Fort Hope, Fraser River (Stearns); Frazer River (Hannibal in lit.).

Washington.—Chehalis River (Cooper, Stearns, Keep); Seattle (Randolph *teste* Hannibal in lit.); Walla Walla (Gould, Stearns); streams running into Puget Sound and most of the branches of the Columbia (Cooper, Stearns); Steillacoom Creek, Puget Sound (Walker).

Oregon.—Klamath River (Lea, Keep, Cooper, Stearns); Shasta River (Stearns); Deer Creek, Yeamill Co.; Rogue River; Deschutes River, Klamath Co.; Douglas Co. (Walker).

Idaho.—Spokane River, Cœur d'Alena (Cooper, Bland, Stearns, Hannibal, Walker); Snake River, Weiser (Hannibal, Walker).

Montana.—Missouri River about the Falls (Bland & Cooper); Gallatin River and head-waters of the Missouri (Call); Crow Creek, Flathead Reservation; tributary of the Pend'Orielle River; "in all the western mountain streams" (Elrod); Bitterroot River (Elrod, Walker).

California.—Yuba River, 40 miles above its confluence with the Feather (Trask, Stearns, Lea, Dall); Sacramento River, Redding (Keep, Pilsbry); Outlet Lake Tahoe, Placer Co., alt. 6247 feet (Cooper); Bear Mountain near Copperopolis; South Pitt River, Likely; Pitt River, Lower Cañon, above Squaw Creek; Sacramento River, Red Bluff; San Lorenzo River at Boulder and Felton, Santa Cruz Co.; Lake Co. (Hannibal); Sacramento River (Gould, Stearns, Dall); McCloud River (Stearns); Stanislaus River (Cooper, Stearns *teste* Hannibal); Santa Cruz (Cooper, Stearns, Dall, Button *teste* Hannibal); Merced Co. (Cooper); Plumas Co., alt. 7400 feet (Dall); Devil's Coral, Plumas Co., alt. 5200 feet (Stearns).

Nevada.—East Humboldt River (Stearns); Humboldt River at Elko (Call); Truckee River (Carlton, Stearns, Call).

Utah.—Salt River, Fort Hall (Cooper, Stearns); Salt Lake City (Call).

Arizona.—"Arizona" (Call, Cooper); Call (1884) gives no exact locality. Cooper's citation (1888) is based on Call's. Mr. Harold Hannibal, of Stanford University, Cal., who has made a special study of the West Coast Unionidæ, informs me that he seriously doubts whether it occurs south of central Nevada.

Saskatchewan, Canada.—Lower Saskatchewan River, near Lake Winnipeg (Dall).

Fossil Records.—It is reported by Call from the Quaternary deposits in the Lahontan Area at Walker River Canyon, Nev., and in the Bonneville area; as semi-fossil at "numerous localities and notably in Sevier Desert". Also from the Tejon formation (Eocene) at Tesla, Cal., by Hannibal.

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EXPLANATION OF PLATE II.

The circular dots indicate the present range of *M. margaritifera* in North America.

The triangular dots that of *M. monodonta*.

The square dots that of *M. Hembeli*.

The X that of *M. decumbens*.

DESCRIPTION OF A NEW SPECIES OF *VOLUTA* FROM
WEST AUSTRALIA.

By Dr. J. C. Cox.

Read 8th April, 1910.

PLATE III.

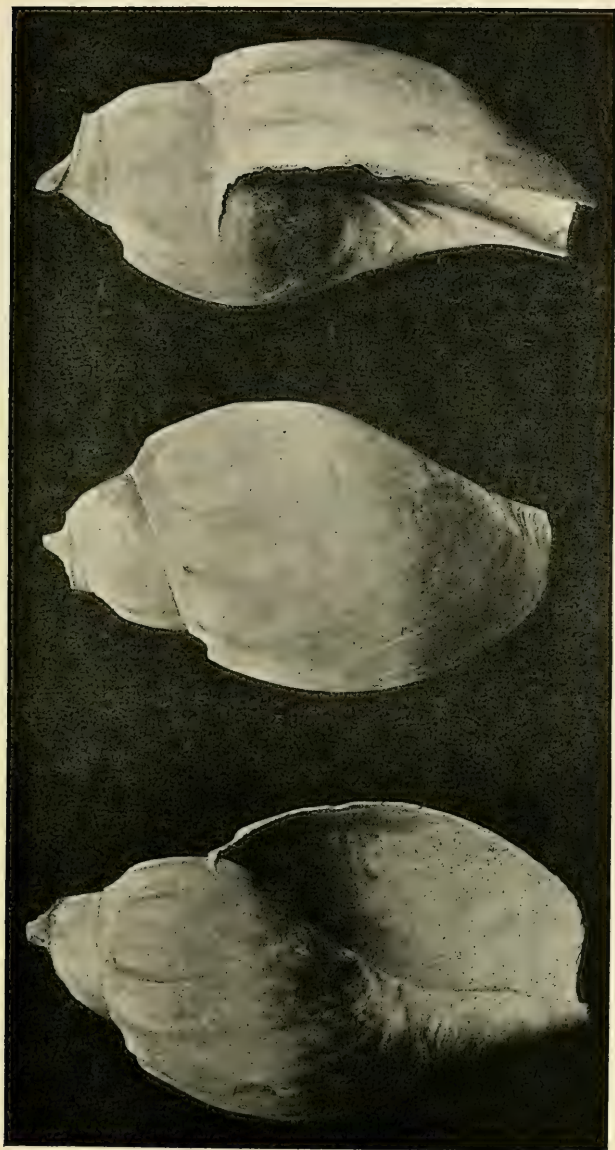
THE shell about to be described was kindly sent me for identification by Mrs. Irvine, of Launceston, Tasmania. Although, unfortunately, the spire has been broken the rest of the specimen is in good condition, and exhibits features which readily distinguish it from other Australian forms.

VOLUTA NODIPLICATA, n.sp.

Shell rather large, fusiformly ovate, rather thin, of an uniformly yellow cream colour, without any trace of colour-markings; whorls? (spire broken); body-whorl ovate, rather inflated, exhibiting at the upper part eleven moderately prominent rounded plicæ, which are nodose about half an inch from the suture, and gradually become obsolete about the middle of the whorl; above the tubercles, which are dark-coloured, the whorl is slightly concave, so that a rounded angulation is formed by the tubercular prominences; the surface exhibits fine lines of growth, which are most distinct near the suture and between the plicæ; columellar folds three in number, well defined, but not conspicuously prominent, the anterior forming the lower columellar margin; outer lip not thickened (immature), showing only a broad shallow anterior notch or sinus. Length (of last two whorls) 125, diam. 80 mm.; aperture 95 mm. in length, 50 in width.

Hab.—Rottneest Island, Western Australia, 12 miles north-west of Fremantle.

This unique specimen was procured from excavations raised during the construction of a pier. It is unfortunate that the spire has been broken, thus preventing the complete description of the apex. It is probable that the outer lip in a more mature specimen would be somewhat thickened.



VOLUTA NODIPLICATA, N.SP.

DESCRIPTION OF A NEW SPECIES OF *LATIRUS*.

By JAMES COSMO MELVILL, M.A., D.Sc.

*Read 8th April, 1910.**LATIRUS ERNESTI*, n.sp.

L. testa mediocri, attenuato-fusiformi, solidiuscula, læté ochraceo-rufa, anfractibus (fortasse) 6-7, quorum apicales . . . (?), cæteris fortiter spiraliter undique tornato-liratis, liris albis, nitidis, inæqualibus, supernis tribus, penultimo sex, ultimo anfractu duodecim liris præditis, interstitiis sub lente delicate alveato-decussatis, apertura ovata, labro paullum effuso, crassiusculo, columella biplicata, canali brevi. Long. 12, lat. 5 mm.

Hab.—Ad Antillarum insulas.



Seawley, del.

This brightly coloured, ochraceous little *Latirus* belongs to the typical section of the genus, its allies being *L. craticulatus*, L., or especially *turritus*, Gmel., of which it seems a miniature resemblance. To *lautus*, Reeve, there is also some affinity, but it differs altogether both in form and quality of ornamentation of sculpture, *lautus* being a more obese species, with irregular longitudinal puckering. Mr. Ernest R. Sykes has asked me to describe this interesting addition to the genus, he having received it with the label "W. Indies". The specimen is imperfect; the apical whorls being missing, we should conjecture that if in first-class condition it would be 6-7 whorled; the mouth, however, and the other parts of the shell are good enough for description. I have pleasure in naming it after Mr. Sykes.



ORDINARY MEETING.

FRIDAY, 13TH MAY, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The President addressed the Members present as follows:—

Before proceeding with the ordinary business of the meeting, I feel that I shall have the approval of all members of the Society in placing upon record an expression of our intense sympathy with the Royal Family in their present bereavement. Mere words are quite insufficient to indicate the greatness and importance of those services which the late King Edward VII rendered to his people and his country. His many-sided interests, coupled with the performance of gracious acts in every department of life, made him the very idol of the nation, and we feel individually that we have lost a friend of long standing. But although the country mourns, as well as the whole civilized world, at so irreparable a loss, it is our part now to encourage with all loyalty and devotion the new Monarch, King George the Fifth, trusting that his reign may be prosperous and happy, and fraught with that same wisdom and tact which so characterized the brilliant though short rule of his late father.

The following communications were read:—

1. "On the Mollusca procured during the 'Porcupine' Expeditions, 1867-70." Supplemental Notes, Part IV. By E. R. Sykes, B.A.
2. "The genus *Cremnobates*, Swainson." By C. Hedley and H. Suter.
3. "Notes on Polyplacophora, chiefly Australasian." Part II. By Tom Iredale.
4. "Notes on and Additions to the Terrestrial Molluscan Fauna of Southern Abyssinia." By H. B. Preston, F.Z.S.

ORDINARY MEETING.

FRIDAY, 10TH JUNE, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The following communications were read:—

1. "A Revision of the Species of the family Pyramidellidæ occurring in the Persian Gulf, Gulf of Oman, and North Arabian Sea." By J. C. Melvill, M.A., D.Sc.
2. "On the Anatomy of *Rhysota Foullioyi*." By R. H. Burne, M.A., F.Z.S.
3. "Further Notes on the Dates of Issue of the Parts of Sowerby's *Conchological Illustrations*." By A. Reynell.
4. "Note on further British Localities for *Pisidium Steenbuchii*, Möller, and *P. Lilljeborgii*, Clessin." By B. B. Woodward, F.L.S.
5. "On *Petricola*, *Lucinopsis*, and the family Petricolidæ." By A. J. Jukes-Browne, F.R.S., F.G.S.

NOTES.

NOTE ON FURTHER BRITISH LOCALITIES FOR *PISIDIUM STEENBUCHII*, MÖLLER, AND *P. LILLJEBORGII*, CLESSIN. (*Read 10th June, 1910.*)—Through the kindness of Mr. C. S. Carter, of Louth, Lincolnshire, I have received specimens of *Pisidium Steenbuchii*, Möll., from two localities in that county, namely, Tetney Lock, near Cleethorpes, and Grisel Bottom, Burwell Wood, near Louth. In the latter locality it is associated with *P. personatum*.

A yet more interesting record is that due to Mr. A. W. Stelfox, who has obtained *P. Steenbuchii* in association with *P. Lilljeborgii* from Keel Lough, Achill Island, co. Mayo, the other species of *Pisidium* present being *P. subtruncatum* and *P. Casertanum*.

In the Collection of the Conchological Society at Manchester are some specimens of *P. Steenbuchii* obtained by Dr. R. F. Scharff at Frankfort-on-the-Main. This is the most southerly locality for it that I am acquainted with.

B. B. WOODWARD.

THE GENUS *CREMNOBATES*, SWAINSON.

By C. HEDLEY and H. SUTER.

Read 13th May, 1910.

A NUMBER of specimens of *Cremnobates parva*, Swainson, collected by Capt. J. Bollons, of the New Zealand Government S.S. "Hinemoa" at the Antipodes Islands, has drawn our attention to this genus, which has been ignored by most conchologists.

The genus was established by Swainson in Proc. Roy. Soc. Van Diemens Land, vol. iii, pt. i, p. 43, pl. vii, fig. 1, January, 1855. It is not *Cremnobates*, Günther, 1861 (Pisces), nor of Blanford, 1863 (Mollusca). The genus has been uniformly omitted by all recorders and monographers. Three species are enumerated—(1) *C. cornea*, (2) *C. parva*, (3) *C. solida*; but the first is *Ophicardelus australis*, Q. & G., and the third *Marinula patula*, Lowe, leaving *C. parva* as the type of the genus.

Swainson gives the following diagnosis: "Animal amphibious. Shell small, oval. Spire rather pointed, as long as the aperture. Aperture not contracted. Pillar, with strong plaits. Inner lip thin, smooth inside."

The following diagnosis of the genus is based on the Antipodes Islands specimens, which fortunately contained the animals preserved in alcohol.

Animal (in alcohol) with short tentacles, the eyes at their inner bases; foot long and narrow, truncated in front, narrowly rounded and simple behind, with a distinct transverse groove at the anterior third of length.

Jaw horny, arcuate, with a median projection below, and a shallow sinus above, vertically narrowly striated, the cutting-edge serrate.

Radula broad and long with numerous transverse, slightly arcuate rows of minute teeth, which are exceedingly numerous, with a long and narrow base, and a minute cusp. A central tooth could not be distinguished.

Shell small, oval, smooth, the spire as high as the aperture or a little less; aperture ovate, not contracted; the outer lip thin and simple; columella with two strong plaits on the upper half.

Distribution.—The type, stated to be in Dr. Milligan's collection, is from Oyster Cove, near Hobart, Tasmania, and a second locality is the Antipodes Islands. The following species are no doubt also members of the genus:—

1. *Marinula Maindroni*, Vélain, Archiv Zool. Expér., vol. vi, p. 126, pl. iv, fig. 26, 1877, from Amsterdam Island.

2. *Marinula nigra*, Philippi: Vélain, op. cit., p. 125, pl. iv, fig. 25, from Tristan da Cunha, St. Pauls and Amsterdam.

Thus the genus would appear to be of circum-Antarctic distribution.

CREMNOBATES PARVA, Swainson, 1855.

Cremnobates parva, Swainson, op. cit., p. 44, pl. vii, fig. 3.

Ophicardelus parvus, Swainson (*Cremnobates*), Tate & May, Proc. Linn. Soc. N.S. Wales, vol. xxvi, p. 420.

Shell ovate, thin, light, covered with an epidermis, spire slender, pointed; pillar plaited; first close to the top of the aperture; the second more towards the base (Swainson). Sculpture consisting of well-marked growth-lines. Colour whitish or light brown, the mouth light to dark brown. Epidermis thin, horny, mostly lost, the surface being corroded. Spire conic, typically of the same height as the aperture, but considerably lower in all the specimens from the Antipodes Islands. Protoconch minute, pointed. Whorls 4, the last very large, convex, a little flattened outside the suture; base flatly



convex. Suture deep. Aperture vertical, ovate, angled above, rounded below. Peristome continuous; outer lip thin and sharp, broadly arched; basal lip regularly convex. Columella slightly oblique, with 2 strong, white plaits, the upper one larger, near the top of the aperture, the lower one smaller and at about the middle of the columella; inner lip smooth, white, spreading a little beyond the columella, and uniting the margins of the peristome by a distinct sharp ridge. There is no trace of an umbilical fissure.

Diam. 5, height 7.5 mm. Largest specimen from the Antipodes Islands.

Animal, jaw, and radula as described for the genus.

Our figure is taken from a specimen collected at Tasman's Arch, South Tasmania, by Mr. W. L. May.

NOTES ON POLYPLACOPHORA, CHIEFLY AUSTRALASIAN. (PART II.)

By TOM IREDALE.

Read 13th May, 1910.

THE GENUS *EUDOXOCHITON*.

On Sunday Island, Kermadec Group, I collected two small shells which superficially seemed referable to *Callochiton*. The girdle appeared to be composed of minute diamond-shaped scales, whilst internally the sutural laminæ were connected. They were, however, traced to *Eudoxochiton*. Upon microscopical examination the girdle was found to be leathery and crinkled, but quite devoid of hairs. Reference showed that a section of *Callochiton* had, instead of a scaly girdle, one with hairs; that was, differing in no way from *Eudoxochiton* save in the nature of the teeth. A member of that section is *inornatus*, Ten.-Woods, an inhabitant of Tasmania; this is a shell much less than *Eudoxochiton*, but still larger than *Callochiton platessa*, Gould. Superficially it would pass for a small *Eudoxochiton*. The coincidence of size, habitat, and facies interested me, and suggested relationship between the two genera. I had not completed my studies when I received Dr. Thiele's work, wherein he transfers *Eudoxochiton* to his sub-family Callochitoninæ. His reasons for so doing appear sound, and in this disposition I would concur. In the present state of our knowledge this seems more suitable than the position selected for *Eudoxochiton* in Pilsbry's classification.

NEW ZEALAND ONITHOCHITONS.

Quoy & Gaimard (Voy. Astrolabe, Zool., vol. iii, p. 393, pl. lxxv, figs. 19-24, 1835) described *Chiton undulatus* as a smooth shell. Reeve wrote (Conch. Icon., pl. xvi, figs. 87-90, sp. 87, 1847), "lateral areas sometimes obscurely ridged." Hutton's description (Man. N.Z. Moll., p. 114, 1880) reads, "with indistinct radiating moniliform ridges."

In the Bull. Soc. Philom., Paris, 1880-1, p. 120, Rochebrune introduced three new species, and the following year in the same Journal, p. 190, duplicated one of these by giving a new name to the same shell as he had previously described. These four names obviously refer to one species, which is as certainly Reeve's *undulatus*.

In the Man. Conch., vol. xiv, p. 247, pl. lv, figs. 10, 11, Pilsbry introduced a new species *semisculptus*, of unknown habitat, and in the next volume, p. 106, referred to Rochebrune's four species as unrecognizable. In 1904 Wissel recorded *semisculptus*, Pils., from the Chatham Islands, and added a new species, *marmoratus*, to the New Zealand list. Suter, the following year (Journ. Malac., vol. xii, p. 71, 1905) reported *semisculptus* also from the Chathams, Wissel's work being unknown to him. Later, Suter (Proc. Malac. Soc., vol. vii, p. 297, 1907) introduced a new species *nodosus*, and then, receiving Wissel's paper, alleged (Nachr. deutsch. malak. Ges., vol. xli, p. 75) that *marmoratus* was simply a colour variant of

undulatus. This view appeared reasonable from Wissel's figures and description (Zool. Jahrb. Syst., vol. xx, p. 660, figs. 67-9, 1904), but Thiele (Revision . . . Chitonen, 1909, p. 99), from an examination of Wissel's type, has shown *marmoratus* to be the shell later named *nodosus* by Suter, Wissel having omitted to point out the salient characters of his species both in the figure and description. Thiele has, moreover, stated that all Rochebrune's species have priority over *semisculptus*, with which they are identical; further, that these are all synonyms of *undulatus*, and I can see no reason for disagreement. The majority of the specimens in the British Museum are "*semisculptus*", and vary so that they become inseparable from a perfectly smooth *undulatus*. If, however, a name is required for this form, *Filholi*, Rochebrune, must be used.

Recently Suter has given the *Onithochiton* from the sub-Antarctic Neozelanic islands varietal rank under the name *subantarcticus*. I have seen many specimens from the Auckland Islands, and upon dissection find that the teeth are much shorter than in *undulatus*. As the internal characters vary very little in *Onithochiton*, the fact that there is a noticeable variation in conjunction with geographical distribution and colour constancy would induce me to give this shell specific rank. Consequently I would recognize three species of *Onithochiton* from Neozelanic waters: *undulatus*, Q. & G., of which *Filholi*, *decipiens*, *Astrolabei*, and *neglectus*, all of Rochebrune, and *semisculptus*, Pilsbry, are synonyms; *marmoratus*, Wissel, of which *nodosus*, Suter, is a synonym; and *subantarcticus*, Suter. Filhol has described *Lepidopleurus Campbells* from Campbell Island (*Comptes Rendus*, vol. xci, p. 1095, 1880). Thiele wrote (Revision, p. 78), "so ist *Lepidopleurus Campbells* ein dunkelbrauner *Onithochiton undulatus*." If this were so the name would be applicable to Suter's var. *subantarcticus*. But Filhol's description, given below, indicates a yellow specimen of *Ischno. Gryei*, Filhol: "Couleur jaune clair, dernière valve plus grand que la première, couverte de lignes concentriques, granulées; aires latérales marquées de lignes concentriques, à cavité supérieure."

CHITON GEORGIANUS, Q. & G.

Chiton Georgianus, Q. & G., Voy. Astrolabe, Zool., 1835, vol. iii, p. 379, pl. lxxv, figs. 25-30.

The type of this species appears to have been lost. It was transferred by Pilsbry (Man. Conch., ser. i, vol. xiv, p. 241) to *Liolophura*. Collected by Quoy & Gaimard at King George Sound, South-West Australia, it has not since been met with by collectors. Search should be made at that locality, and the species either rehabilitated or eliminated. From Quoy's good description and figures it would seem to be a valid species. Another doubtful inhabitant of the same locality is *Chatopleura biarmata*, Roch. (Bull. Soc. Philom., 1881-2, p. 195), which Thiele (Revision, ii, p. 73, pl. vii, figs. 19-26) has shown to be a good species and a *Chatopleura*. This genus has not been recorded from Australia. *Chiton Dieffenbachii*, Reeve, Newcastle, Australia, was included by Pilsbry (Man. Conch., vol. xiv, p. 35) as a *Chatopleura*, and was

suggested to be a synonym or variety of *C. lurida*, Sowb., from Peru. The type tablet was marked Peru, and the shell is *lurida*, Sowb., so that it is certain that Reeve's locality is erroneous.

CHITON (CALLISTOCHITON) COPPINGERI, Smith.

C. (C.) Coppingeri, Smith, Zool. Alert, 1884, p. 80, pl. vi, fig. e.

Though included in the Man. Conch., vol. xiv, p. 275, as a *Callistochiton*, Pilsbry later (Proc. Ac. Nat. Sci. Phil., 1894, p. 72) stated his belief that this was the young of *Ischnochiton fruticosus*, Gould. Examination of the type enables me to confirm this conjecture.

AUSTRALIAN ACANTHOCHITES.

The numerous species recently described makes it difficult to assign any specimens without careful comparison of typical shells. Therefore Dr. Thiele (Revision . . . Chitonen, i, p. 48) has left the identification of Rochebrune's and Blainville's species to Australian Chiton students. He has pointed out, however, that *Sueurii*, Blainv., must replace the familiar *asbestoides*, Smith. From the good figures of *scaber*, Blainv., given by Thiele, it should be easily identified if Australian.

Acanthochites turgidus, Roch., alleged to have been collected by Péron et Lesueur, may be *Bednalli*, Pilsbry.

Acanthochites jucundus, Roch., supposed to have been collected in New Holland by Belligny, and Cooks Straits by Filhol, I should cross off the Australian list until rediscovered. The Cooks Straits shells Thiele admits to be *Zelandicus*, Q. & G., and the New Holland shells I should certainly so name. The bottle contained about a dozen specimens, and it is almost impossible to suggest the occurrence of so plentiful a shell in Australian waters without any collector retaking it. Rochebrune has named a shell *Ac. Bellignyi*, apparently collected in New Caledonia by Belligny. Thiele's examination of the type proves it to be identical with *jucundus*, and I conclude this habitat must also be doubted. From my studies of these specimens and localities, I must advocate the non-acceptance of any of these species without confirmation.

Acanthochites tristis, Roch., I would consider the same as the species described by Thiele as *Thilenuisi* from New Zealand. No certainty can be arrived at without examination of suites of specimens in this genus, the variation in *Acanthochites* being unknown. The sculpture and form become modified by the action of environment, and this has not yet been taken into consideration when describing new species. I am led to make this statement by the examination of a series of *Acanthochites rubiginosus*, Hutton. Suter figures a short broad low shell, and this form I have seen from Stewart Island. A series dredged by Macgillivray in the Hauraki Gulf consists almost entirely of elongate, narrow, very highly keeled shells, only one, a young specimen, being short, broad, and low. Another lot collected by the early explorers is mixed, but again high-keeled forms predominate. The sculpture is quite variable, the pustules varying tremendously in size, and also in shape, whilst the ribbing on the anterior valve is quite an uncertain feature, in two instances

being absolutely missing. All the specimens of *laqueatus*, Sowb., I have yet seen have been low shells with the tail-valve many-slit, whilst the *rubiginosus*, Hutt., have all had few slits in that valve. But the number of slits is quite variable also, and these facts must be borne in mind when the differentiation of species of *Acanthochites* is undertaken.

ABNORMAL CHITONS.

In the Trans. N.Z. Inst., vol. xi, p. 375, 1907 (1908), I recorded the occurrence of a five-valved specimen of *Chiton pellis-serpentis*, Q. & G., and a six-valved *Plaxiphora ovata*, Hutton, commenting upon the scarcity of such finds. I had never seen a seven-valved specimen at that time, nor have they been frequently met with by any collector. Yet they would appear to be more common than records show, or else I have been peculiarly fortunate. At Port Curtis, Queensland, I collected all the specimens of *Sclerochiton Curtisianus*, Smith, only sixteen in all, I could find, yet among these was a beautiful seven-valved shell. As this had not been detected whilst collecting, it caused me to look through my Kermadec shells, with the result that I unearthed two seven-valved Ischnochitons, one of which I have unfortunately mislaid. At Seascale, Cumberland, England, the only Chiton I could find was *Cras. cinereus*, Linn., but I was exceedingly gratified to note a seven-valved specimen. This is the first one I have seen living.

How easily abnormalities can be passed over is evidenced in the British Museum by a series of six *Plaxiphora Matthewsii*, Iredale, collected by Mr. Matthews and presented by Mr. Bednall. Though such keen collectors, it would appear they have overlooked that one of these has only six valves.

QUEENSLAND POLYPLACOPHORA.

When Chiton-collecting in New Zealand I became interested in Australian forms, and through the co-operation of my esteemed correspondents, Messrs. E. H. Matthews and A. F. Basset Hull, I acquired a fairly representative collection of the Chitons of Southern Australia. I drew up some tables showing the distribution of the recorded species, and much of interest revealed itself. Two noticeable features were the poverty of the known Tasmanian fauna and the entire lack of Queensland records. The former, I believe, is due to the greater attention given to these molluscs in other states, not to the inferiority of the fauna. In respect to the latter no collections appear to have been recorded, and very little attention has been paid to the collection of Chitons. In February, 1909, the opportunity presented itself to me of investigating the Chiton fauna of sub-tropical Queensland. I have just received from Mr. Hedley his Catalogue of the Marine Mollusca of Queensland (Proc. Aust. Ass. Adv. Sci., 1909), and on p. 352 he only totals twenty species in the class Amphineura, of which two are Aplacophora. In view of this list and the collections I made, it seems opportune to record the latter with some comments

on their nature. Since I drew up these notes I have read Hedley's paper in the P.L.S. N.S.W., vol. xxviii, 1903, on the effect of the Bassian Isthmus on the Marine Fauna of Australia. As my studies in Chitons completely confirm his conclusions, I am herewith amplifying my previous report by incorporating a short account of the Australian Chiton fauna in the terms introduced by Hedley in that paper. Consequently this note has developed into a review of that class of the marine Mollusca of Southern and Eastern Australia, practically forming an Appendix to Hedley's essay. In the place quoted Hedley introduced some new names for the divisions he proposed as follows: the extent of Southern Australia from Melbourne to Westralia he calls the *Adelaidean Region*; the east coast of Tasmania, Gippsland, and New South Wales constitute the *Peronian Region*; the Queensland coast from Moreton Bay to Torres Straits he terms the *Solanderian Region*; whilst from Torres Straits to Houtman's Abrolhos is named the *Damperian Region*. It must be remembered that these terms apply to the marine fauna only, and that the Solanderian and Damperian are only subdivisions of the Indo-Pacific fauna, and that the Peronian and Adelaidean Regions are only subdivisions of the Euronotian or Bassian fauna. Hedley notes that considerable interchange has taken and is yet taking place between the Peronian and Adelaidean Regions.

To return to the Queensland Polyplacophora: the list made up by Hedley consists almost entirely of Torres Straits, Port Molle, and Port Curtis records. It is at once recognized as typically Solanderian, no fewer than twelve of the eighteen species being confined, as far as the east coast of Australia is concerned, to Queensland, north of Moreton Bay. I collected at Caloundra, just north of Brisbane, and there procured some fifteen species and one variety, all of which, with one exception, have been obtained at Port Jackson, New South Wales, and no fewer than ten species are additions to Hedley's list. At Port Curtis, about 300 miles to the north, this fauna is non-existent. As I will shortly show, Australian Chitons have very limited range, and the fact that the Peronian Chitons die out between Caloundra and Port Curtis shows Hedley's limits for his regions to be maintained by the study of this class. The species I collected at Caloundra were—

**Plaxiphora costata*, Blainv.

**Acanthochites costatus*, Ad. & Ang.

**A. variabilis*, Ad. & Ang.

**A. retrojectus*, Pils.

Callistochiton antiquus, Reeve.

**Chiton limans*, Sykes.

**C. n.sp.*, near *Cozi*, Pils.

C. translucens, Hedley & Hull.

**Callochiton platessa*, Gould.

Onithochiton quercinus, Gould.

Liolophura Gaimardi, Blainv.

Ischnochiton australis, Sowb.

**I. crispus*, Reeve.

**I. divergens*, Reeve.

**I. smaragdinus*, Angas.

**I. smaragdinus picturatus*, Pils.

Those not included in Hedley's list are marked with an *.

I have collated a total of ninety-five Chitons for Australia, of which, politically, twenty-eight belong to Queensland, thirty-one to New South Wales, thirty-seven to Victoria, fifty-two to South Australia, and twenty-five to Tasmania. I have only one record from West Australia, though I have seen three species purporting to come from

the Swan River. All the three appear distinct from Adelaidean forms. Biologically the species may be proportioned thus:—

SOLANDERIAN.

Ischnochiton Adalaidensis, Reeve.
Sclerochiton miles, Pils.
S. Curtisianus, Smith.
Chiton pulcherrimus, Sowb.
Schizochiton incisus, Sowb.
Cryptoplax Burrowi, Smith.
C. oculatus, Q. & G.
Onithochiton quercinus, Gould.
Tonicia fortilirata, Reeve.
T. picta, Reeve.
T. confossa, Gould.
Acanthopleura spinosa, Brug.
A. spiniger, Sowb.

PERONIAN.

Lepidopleurus badius, H. & H.
Ischnochiton divergens, Reeve.
I. fruticosus, Gould.
I. lentiginosus, Sowb.
I. smaragdinus, Angas.
I. australis, Sowb.
Chiton pellis-serpentis, Q. & G.
C. limans, Sykes.
C. jugosus, Gould.
C. Coxi, Pils.
C. translucens, H. & H.
C. Vaclusensis, H. & H.
Plaxiphora Peteliana, Thiele.
Chorioplax Grayi, Ad. & Ang.
Callochiton platessa, Gould.
Cryptoplax striatus, Lam.
Tonicia Carpenteri, Angas.
Acanthochites costatus, Ad. & Ang.
A. Coxi, Pils.
A. retrojectus, Pils.

DAMPERIAN.

Onithochiton Scholvienei, Thiele.

DEEPWATER SPECIES.

Lepidopleurus columnarius, H. & M.

DOUBTFUL POSITION.

Ischnochiton crispus, Reeve.
Chiton, n.sp., near *Coxi*, Pils.
Liolophura Gaimardi, Blainv.
Callistochiton antiquus, Reeve.
Lorica volvox, Reeve.
Loricella Angasi, Ad.
Callochiton inornatus, Ten.-Wds.
Acanthochites Sueurii, Blainv.

ADELAIDEAN.

Lepidopleurus inguinatus, Reeve.
L. Matthewsianus, Bedn.
L. cancellatus, Sowb. (?).
Ischnochiton juloides, Ad. & Ang.
I. Pilsbryanus, Bedn.
I. pallens, Ashby.
I. cariosus, Pils.
I. virgatus, Reeve.
I. contractus, Reeve.
I. sulcatus, Q. & G.
I. carinulatus, Reeve.
I. arbutum, Reeve.
I. Novæhollandiæ, Reeve.
I. Mayi, Pils.
I. pura, Sykes.
I. Wilsoni, Sykes.
I. Pilsbryi, Bedn.
I. variegatus, Ad. & Ang.
I. ptychius, Pils.
I. Tateanus, Bedn.
I. Tateanus, var. (= n.sp.).
I. Thomasi, Bedn.
I. resplendens, B. & M.
I. sculptus, Sowb.
I. ustulatus, Reeve.
Chiton tricostralis, Pils.
C. calliozona, Pils.
C. exoptandus, Bedn.
C. Torrianus, H. & H.
C. aureomaculatus, B. & M.
C. Bednalli, Pils.
C. Veronis, Torr & Ashby.
C. oruktus, Maughan.
Plaxiphora albida, Blainv.
P. costata, Blainv.
P. Matthewsii, Iredale.
Callochiton rufus, Ashby.
Cryptoplax Gunnii, Reeve.
Onithochiton Ashbyi, B. & M.
Acanthochites speciosus, H. Ad.
A. Bednalli, Pils.
A. Pilsbryi, Sykes.
A. Matthewsii, Bedn. & Pils.
A. glyptus, Sykes.
A. Wilsoni, Sykes.
A. granostriatus, Pils.
A. variabilis, Ad. & Ang.
A. cornutus, T. & A.
A. crocodrilus, T. & A.
A. exilis, T. & A.
A. Tatei, T. & A.
A. Maughani, T. & A.

We have thus thirteen species allotted to the Solanderian Region, only one of which ranges into the Peronian; twenty Peronian species, of which seven have reached into the Adelaidean Region; of the

fifty-two species I consider Adelaidean only five have as yet been recognized in the Peronian fauna. I know only one Damperian species which does not elsewhere occur. The solitary Chiton at present known from deep water does not concern us. It is of peculiar interest that out of the total of ninety-five species only eight do not easily become placed.

Ischnochiton crispus, Reeve, *Lorica volvox*, Reeve, *Loricella Angasi*, Ad., and *Acanthochites Sueurii*, Blainv., appear to be as plentiful in the Peronian as in the Adelaidean, whilst the last-named ranges into the Solanderian. *Liolophura Gaimardi*, Blainv., is placed by Hedley as a characteristic Peronian mollusc, but I should consider it Solanderian. *Callistochiton antiquus*, Reeve, though found of large size in South Australia, seems Solanderian, but I have not sufficient data to decide.

Callochiton inornatus, Ten.-Wds., I suggest should be attached to the Peronian fauna. The *Chiton* near *Coxi*, Pilsbry, may be Solanderian, but I doubt it. All the preceding figures will need revision when Gippsland and Eastern Tasmania receive as careful attention as South Australia, Port Phillip, or Port Jackson have done. Nevertheless, it will be seen that study of the Chiton faunas shows the extreme localization of species, and consequently points to some apparent misidentifications in the preceding lists.

Chiton pulcherrimus, Sowb., included in Hedley's Catalogue, would appear to need another name, Sowerby's species being recorded from Bohol Island, Philippines. *Tonicia confossa*, Gould, also in Hedley's list, needs reconsideration, though this latter is more probable than the former, the species of *Tonicia* having a wider range than those of *Chiton*, but neither extend far.

The record of *Lepidopleurus cancellatus*, Sowb., from Victoria is obviously incorrect; another dubious record from that locality is *Ischnochiton arbutum*, Reeve; when described, no locality was known; Pilsbry has added Port Essington. From the preceding lists it is argued that both records cannot be accepted. I do not know where the type was collected, so have included Gatliff and Gabriel's shell, though the identification is questionable.

The Euronotian Chiton fauna is characterized by an extraordinary development of the genera *Ischnochiton* and *Acanthochites*; of both these, species are much more numerous in the Adelaidean Region.

Hedley has stated that a collection of Marine Molluscs received from Geraldton, West Australia, was essentially Adelaidean, though masked by an overlap of Indo-Pacific forms. I conclude that the Chiton fauna of West Australia will be of a most interesting nature. It will contain representatives of the Adelaidean Region, Damperian species will also occur, and I anticipate the existence of a few peculiar forms representing the Autochthonian element.

I have omitted from consideration the species described by Blainville, Rochebrune, etc., from "New Holland", which have not yet been recognized, as they probably appear in the lists under different names.

I have just been looking up records of marine molluscs from West

Australia, and, though scanty, there appears distinct evidence of an Antarctic element which has not arrived there via Tasmania. I suggest an Autochthonian element showing forms more closely allied to Neozelanic species than to Euronotian, and that this will be clearly shown by the study of the Chiton fauna.

KERMADEC ISLANDS CHITON FAUNA.

In the preceding note I have discussed the complex nature of the Australian Polyplacophora and how the forms resolve themselves into four groups, agreeing with the divisions of the Australian marine fauna proposed by Hedley.

"It is to be noted that the Antarctic fauna which passed over New Zealand is quite distinct from, and probably far older than, that other Antarctic element, the Euronotian, which reached Australia through Tasmania" (Hedley, P.L.S. N.S.W., 1899, p. 399).

In support of this may be cited the Neozelanic Chiton fauna, which differs essentially from the Euronotian Chiton fauna. The noticeable features are the poverty of species of *Ischnochiton*, the large size of the *Acanthochites*, the distinct nature of the *Plaxiphora* and *Onithochiton*, and the presence of the genus *Eudoxochiton*.

The Chitons collected at Sunday Island agree in the majority of these items, yet possess so many peculiarities that they deserve some little notice. *Eudoxochiton* is endemic in Neozelanic waters with two distinct species. *E. nobilis*, Gray, lives on the surf-swept boulders, and its form and internal characters are well suited to withstand the force of the waves. *E. Huttoni*, Pilsbry, is easily separated by its much more depressed form and longer teeth, it is only found on the most exposed situations, and would appear to be much rarer. Which is the parent or to which would the parent form be more like would be difficult to suggest. The question is more complicated by the finding on Sunday Island of two forms of *Eudoxochiton*. The occurrence of this genus so far north was entirely unexpected, *Acanthopleura* being anticipated instead. The existence of that genus in New Zealand now depends on the record of two specimens of a West Indian species supposed to have been collected there. As no locality or collector is known, surely no acceptance can be given to such records in the face of the examination of the Australian Polyplacophora. *Acanthopleura* has a wide range, but in Australia it does not extend much outside the tropics. The occurrence of an Australian species of that genus in New Zealand would be doubted; how much more doubt must be received by the report of a West Indian species? The *Eudoxochitons* of Sunday Island are very puzzling, as the existence of two forms on such a small island I could scarcely credit myself. Yet the shells seem easily separable into two lots, which might be classed as varieties of *nobilis*, Gray: they differ in general form as much from each other as from that species, and are both less elevated. One form is even lower than *Huttoni*, Pils., though in the characters and number of the teeth it absolutely agrees with the other. I have so far been unable to provide a satisfactory explanation for the differentiation of these from

each other, and from the Eudoxochitons of New Zealand. A species of *Plaxiphora* was obtained which agrees with the New Zealand *calata*, Reeve, in everything save girdle-characters. It has the girdle densely crowded with hairs instead of with few hairs, as in that species. All the specimens collected agreed in this respect. A beautiful smooth *Onithochiton* in the characters of the valves, externally and internally, cannot be separated from smooth *undulatus*, Q. & G. But its girdle is clothed with slender glassy spikes like that of *Onithochiton amicorum*, Baird, from Niue. I have examined the type of this species, and though it is in bad condition it is certainly an *Onithochiton*. A *Chiton* was procured which had developed most peculiar habits: it lived in crevices of rock between tide-marks, huddling together, half a dozen being found one upon another, so that some did not touch the rock at all. This species was entirely black, and allied to *pellis-serpentis*, Q. & G. A small *Lepidopleurus* was living under dirty stones below low-water. It was only on the underside of stones deeply embedded. On smooth stones just below low-water lived species of *Chiton*, of the *æreus*, Reeve, group, and *Ischnochiton*, of the *crispus*, Reeve, group. I have written species, as I have so far failed to realize how many or how few I have collected. The shells can be separated into three forms of *Chiton* and two of *Ischnochiton*, but I am almost in the position of the ornithologist who could see the differences but could not write them down. If these forms could be classed as variations of one species of each genus, that would seem best, but then we are confronted with the facts that *C. æreus*, Reeve, and its relations are very constant, as also is *I. crispus*, Reeve. Then how should a species of such groups commence varying under such restricted conditions as is offered them on such a small area? These forms were all living under absolutely the same conditions, so that I have been forced to suggest that they present convergence of species through the action of identical external conditions. From 15 to 25 fathoms was dredged a fine *Lepidopleurus*, which has no near relation yet on record. It faintly resembles some Japanese species. From a piece of coral pulled out of 6 feet of water at low tide a small *Tonicia* was detached, whose affinities are Polynesian. As valves of similar size were common in dredgings, it would appear to be adult. Associated with these were valves of two small species of *Acanthochites*, a genus not otherwise met with. That the Chitons were not completely collected was evidenced by finding a valve of a large Chiton, apparently a *Cryptoconchus*, in shell-sand on an exposed piece of the coast. When the Chitons of New Caledonia are more fully known than at present, I believe they will show near relationship to those of New Zealand. When Suter described *Chiton Huttoni* (T.N.Z.I., vol. xxxviii, p. 329, 1905 (06)), he remarked, "the affinities of the marine molluscs of New Caledonia and New Zealand are slender." But that species and *C. æreus*, Reeve, have a very close ally in the New Caledonian *C. discolor*, Soubervie (= *minaceus*, Cpr. MSS., and *perpunctatus*, Cpr. MSS.); and the more recently described *Chiton clavatus*, Suter (Proc. Malac. Soc., vol. vii, p. 296, fig. 3, 1907), from New Zealand, seems very near *Chiton*

tuberculosis, Sowerbie (Journ. de Conch., p. 251, pl. ix, fig. 3, 1866), from New Caledonia, but this species was compared by the author with the New Zealand *Chiton pellis-serpentis*, Q. & G.

In a preceding note I have observed that to me *Acanthochites jucundus*, Roch., appears conspecific with the New Zealand *Acanthochites Zelandicus*, Q. & G. Dr. Thiele states that *Acanthochites Bellignyi*, Roch., described as from New Caledonia, is identical with *Acanthochites jucundus*, Roch. Confirmation of the locality will add interest to the question, as then, though specific differences may be observed, the shells will be another connecting link.

Through the energy and enterprise of Mr. A. F. Basset Hull, the most enthusiastic Chiton student in Australasia, the Chiton faunas of Lord Howe and Norfolk Islands will shortly be made known. I have had the pleasure of examining his collections, and find they are more probably closely allied to New Caledonian forms than to Peronian species. A *Chiton* and *Ischnochiton* were obtained from Norfolk Island which may agree with one of the puzzling forms mentioned above from the Kermadecs. The *Chiton* of *pellis-serpentis* alliance from the Kermadecs was represented on both Lord Howe and Norfolk Islands by shells which seem distinct from each other. From Lord Howe Island comes a *Lepidopleurus*, which appears to rank between *L. badius*, H. & H., from Port Jackson, New South Wales, and the species from the Kermadecs. An *Acanthochites* and *Onithochiton* were also procured, whose relationships must be sought for among New Caledonian forms. I have concluded that by means of a close study of the Chitons of the Southern Hemisphere we shall be able to trace the source of almost all the species, and the value of such knowledge cannot be over-estimated.

NOTES ON AND ADDITIONS TO THE TERRESTRIAL MOLLUSCAN
FAUNA OF SOUTHERN ABYSSINIA.

By H. B. PRESTON, F.Z.S.

Read 13th May, 1910.

HAVING recently received two small consignments of land shells from the neighbourhood of Harar, Southern Abyssinia, I have had occasion to study the somewhat scanty literature on the Mollusca of that country. Judging from the number of species sent home from Harar alone, the fauna would appear to be extremely rich and varied, and perhaps this is not surprising when the configuration of the country is taken into account. A glance at the map will show that the whole region is a long series of chain after chain of mountains, rising to an average altitude of 4500 feet, between which occur very hot and arid valleys, and thus it is scarcely to be wondered at, considering the geographical position of the country, that some species almost of a palaearctic character should be met with in company with others which certainly have great affinities with those of the damp and dense forests of other parts of tropical Africa.

It seems probable that little collecting has ever been done in the district immediately surrounding Harar, although in 1874 Jickeli¹ noticed and described many forms from Abyssinia; his work covered the then known Mollusca of a scarcely explored tropical country nearly, if not quite, as large as Spain. Nine years later Bourguignat wrote his "*Histoire Malacologique de l'Abyssinie*"², in which a number of new forms were described chiefly from Northern and Central Abyssinia, whilst more recently M.M. Neuville and Anthony have published four short lists,³ culminating in a descriptive paper⁴ based on the material obtained by themselves as members of the expeditions of M. Maurice de Rothschild. Though a certain amount of their material was collected in the Dirre Daona and Tchercher Districts, the former directly to the north, and the latter some distance to the east-south-east of Harar, they do not seem to have met with many of those species now sent home from the immediate vicinity of that city, and I think there can be little doubt that when the whole country is carefully and extensively explored the local fauna will be found to be an extraordinarily rich one. All the following species are from Harar, Southern Abyssinia.

¹ "Fauna der Land und Süßwasser-Mollusken Nord-Ost-Afrikas": Nov. Act. Ksl. Leop.-Carol. Deutsch. Akad. Naturforscher, Dresden, 1874, vol. xxxvii.

² *Annales des Sciences Naturelles, Zool.*, t. xv, 1883.

³ *Bull. Mus. Hist. Nat. Paris*, 1905, No. 2, p. 115; No. 3, p. 196; 1906, No. 5, p. 319; No. 6, p. 411.

⁴ "Recherches sur les Mollusques d'Abyssinie (Matériaux de la Collection Maurice de Rothschild)": *Annales des Sciences Naturelles, Zool.*, t. viii, 1908.

ENNEA ROBERTI, n.sp.

Shell shortly cylindrical, obtuse, imperforate, cream-coloured, smooth, somewhat polished; whorls 7, flat; sutures lightly impressed, narrowly margined; labrum white, rather broadly reflexed; aperture sub-semicircular, bearing a strong, curved, parietal lamella, a group of three lamellæ on the outer wall, of which the middle one is the largest and broadest, a strong revolving lamella at the base of the columella, and above this, and situate well within the shell, a squarish, shelf-like projection, the lower portion of which is thickened into



a strong, white, nodulous tooth grooved down the centre. Alt. (of type-specimen) 12, diam. maj. 3 mm.; aperture, alt. 2, diam. 1.5 mm.

A remarkable shell of which three specimens were collected. These vary in size, the largest being 13, whilst the smallest is only 11.25 mm. in length.

Two of the specimens, though quite fresh-looking, appear to have been neatly bored, on one of the earlier whorls, by some enemy, the hole, though small, being in each case very similar to the circular holes caused by the depredations of *Nassa* on other marine species.

ENNEA MENELEKI, n.sp.

Shell cylindrical, obtuse, white, polished, shining; whorls 9, flat, the last bistrangulate at the base; sutures incised, roughly crenellate; labrum white, thickened, narrowly reflexed; aperture sub-quadrate, bearing a single obliquely curved parietal lamella, two nodulous basal



lamellæ, one situated below the other on the outer wall, and a broad, squarish, shelf-like tooth at the base of the columella. Alt. 6.25, diam. maj. 2 mm.; aperture, alt. 1.25, diam. .75 mm.

HELICARION HARARENSIS, n.sp.

Shell inflated, with depressed spire, moderately large and solid, the earlier whorls pink, the last two pale olive-green; whorls 4, marked with transverse, arcuate growth-lines; sutures impressed, margined,

whitish; base of shell convex; columella white, excavated, a thin, roughish callus joining it with the lip above; labrum acute, arcuate;



aperture wide, ovate. Alt. 15·5, diam. maj. 24, min. 16·75 mm.; aperture, alt. 14, diam. 14·5 mm.

HELICELLA (LEJEANIA) ROSENBERGI, n.sp.

Shell globosely turbinate, perforate, slightly shining, pale brown, painted with transverse streaks and spiral bands of white; whorls 6, flattened, the last descending in front, sculptured with coarse, transverse, arcuate riblets, and undulating, spiral, scratch-like striæ; sutures somewhat lightly impressed, minutely crenellate; base of shell moderately inflated; umbilicus somewhat open, deep; columella



reflexed, whitish, descending obliquely, excavated in the middle; labrum thin, acute, slightly reflexed; aperture oblique, broadly sub-lunate. Alt. 11·25, diam. maj. 16, min. 13·5 mm.; aperture, alt. 6·75, diam. 6 mm.

A very variable species of which the principal forms are described below.

Var. *DEPRESSA*.

Much more depressed than the typical form. Alt. 7, diam. maj. 13·5, min. 13 mm.; aperture, alt. 5, diam. 6 mm.



Var. *ALBIDA*.

More depressed than the type and nearly white, the brown ground colouring being changed to very pale greyish-white, whilst the white bands and streaks remain in an intensified form. Alt. 8, diam. maj. 14·25, min. 10·5 mm.; aperture, alt. 5·75, diam. 6 mm.

BULIMINUS AFFINIS, n.sp.

Shell small, thin, hyaline, the earlier whorls bronze-coloured, the later yellowish-brown horn colour; whorls $6\frac{1}{2}$, convex, sculptured with very fine, regular, oblique, transverse growth-striæ; sutures

deeply impressed; perforation very narrow, almost concealed by the reflexion of the columella; columella reflexed, diaphanous; labrum simple; aperture ovate. Alt. 10, diam. maj. 5, min. 4·5 mm.; aperture, alt. 3·5, diam. 2 mm.



Very closely allied to *B. eminulus*, Mor., but differing from that species in having broader and less convex whorls; moreover, in the present species there is one whorl less than in *B. eminulus*.

CERASTUS OLIVIERI, Pfr.

A number of specimens in every stage of growth and showing great variation, the dimensions of the smallest and largest adults being as follows (measurements in millimetres):—

<i>Smallest.</i>		<i>Largest.</i>	
Alt.	22·5	Alt.	34·25
Diam. maj. . . .	13	Diam. maj. . . .	16
Diam. min. . . .	11·75	Diam. min. . . .	14·75
Aperture, alt. . .	11	Aperture, alt. . .	15
Aperture, diam. .	5·5	Aperture, diam. .	6·75

CERASTUS NEUMANNI, Kob.¹

A few examples which I am unable to separate from the specimen of this species in the British Museum, and which was originally described from the neighbourhood of Harar.

CERASTUS SINUOSUS, Bgt.²

Also a few specimens, smaller, shorter, and rather more globose than the last, and which, judging from the figures and dimensions which I have seen of this species, I am able to refer to it.

CLAUSILIA SENNAARIENSIS, Pfr.

A number of specimens which show some variation in length, though the sculpture is in all cases very constant; the largest is 13 mm. long, whereas the smallest is but 10·75.

ACHATINA ARIEL, n.sp.

Shell small, subulately fusiform, thin, transparent, pale yellow; whorls 8, sculptured, especially above, with fine, irregular, transverse riblets; sutures impressed, somewhat crenellate, very narrowly

¹ Martini-Chemnitz, Syst. Conch. Cab., Die Bulimidae, Theil ii, p. 745, sp. 417, pl. ex, figs. 1, 2.

² "Histoire Malacologique de l'Abyssinie": Annales des Sciences Naturelles, Zool., t. xv, p. 49, fig. 63, 1883.

margined; columella vertically descending, obliquely truncate; labrum simple, acute; aperture elongately inversely auriform. Alt. 18, diam. maj. 7·75, min. 7 mm.; aperture, alt. 8, diam. 3·75 mm.



A delicate little species which is perhaps the least of the true *Achatina* yet described. Notwithstanding the small dimensions of the specimens before me, I think there can be no doubt that they are fully adult.

LIMICOLARIA JICKELIANA, n.sp.

Shell elongately ovate, white, painted with reddish chestnut transverse flame markings; whorls 7, moderately inflated, presenting a somewhat finely malleated appearance; sutures impressed, crenellate with the lines of growth; umbilicus very narrow, deep, half concealed by the reflection of the columella; columella white, reflexed, slightly excavated above, descending vertically, a thin callus joining it with the lip above; labrum acute, aperture broadly inversely auriform; interior of shell very pale bluish white, and showing the chestnut



colour-bands through the shell. Alt. 34·5, diam. maj. 18, min. 16·5 mm.; aperture, alt. 15, diam. 8 mm.

Allied to *L. oviformis*, Ancey,¹ from the Somali coast, but smaller, with less inflated whorls, straighter columella, and lacking the fine decussate sculpture of that species.

A specimen of the egg was also sent home with the shell; its dimensions are, length 5·25, breadth 3·5 mm.; it is elongately ovate, calcareous, and of a dirty white colour.

¹ Nautilus, vol. xiv, p. 42; Journ. de Conch., vol. xlix, p. 140.

HOMORUS PRINCEPS, n.sp.

Shell moderately solid, with blunt apex; earlier whorls pale yellowish white, later whorls painted and transversely streaked and banded with reddish and blackish brown; whorls 10, somewhat flattened, sculptured with fine transverse striæ crossed by fine spirals, thus presenting a finely decussate appearance; base of shell smooth excepting lines of growth; sutures impressed, crenellate; columella



obliquely curved, abruptly truncate; labrum acute, simple; aperture inversely auriform; interior of shell polished, bluish white, shading to a violet hue near the aperture. Alt. 51, diam. maj. 15, min. 14 mm.; aperture, alt. 14.5, diam. 6.5 mm.

A very handsome species whose large size and finely decussate appearance easily separate it from other Abyssinian members of the group.

HOMORUS PERLUCIDA, n.sp.

Shell solid, subulate, with sub-mamillary apical whorls, thin, transparent, polished, shining, pale yellow; whorls 9, flattish, faintly marked with fine transverse growth-lines; sutures impressed, margined below; columella excavated above, descending in a curve; labrum



simple, acute; aperture inversely auriform. Alt. 13.5, diam. maj. 3, min. 2.75 mm.; aperture, alt. 3, diam. 1.75 mm.

A pretty little species, and one which would seem to be very hardy, as many of the specimens revived when placed on damp wadding and

devoured lettuce with avidity; the animal is dorsally of a slaty-black colour, shading to dirty greyish yellow on the foot and posterior portion of the body; they are very sluggish in their movements, trailing their heavy shells behind them as they crawl; nearly all the shells contained eggs, which were, in a few cases, pushed out as the animal emerged. They are large for the size of the animal, very white, elongately oval, and calcareous; measuring 1.5 mm. in length by 1 mm. in breadth.

ITIOPIANA, n.sect.

Shell differing from *Subulina* (*sensu stricto*) in having all but the embryonic whorls finely decussately sculptured.

SUBULINA (ITIOPIANA) MENELEKI, n.sp.

Shell subulate with sub-mamillary apical whorls, rather thin, pale yellowish brown; whorls $12\frac{1}{2}$, somewhat flat, the earlier whorls minutely pitted, the later whorls indistinctly spirally striate and sculptured with fine, very closely set, transverse striæ; sutures



impressed, slightly crenellate; columella curved and slightly twisted, rather abruptly truncate; labrum thin, acute; aperture inversely auriform. Alt. 29.75, diam. maj. 6.25 mm.; aperture, alt. 6.25, diam. 3 mm.

SUBULINA (ITIOPIANA) VICINA, n.sp.

Shell subulate with sub-mamillary apical whorls, rather thin, pale waxy yellow; whorls 12, moderately convex, the first two and a half smooth, shining, the later whorls finely, spirally striate, and sculptured with fine, very closely set, transverse striæ, giving to the shell a minutely decussate appearance; sutures impressed, scarcely crenellate; columella somewhat obliquely curved, obliquely truncate below, and diffused above into a thin, whitish callus, which extends upwards to the insertion of the last with the penultimate whorl, but does not quite reach to the margin of the aperture; labrum acute(?); aperture inversely auriform. Alt. (of largest specimen, allowing for the apical whorls) 21.5, diam. maj. 6.5 mm.; aperture, alt. 6.5, diam. 2.5 mm.

Differing from the last species by its smooth apical whorls, more convex lower whorls, and more deeply impressed though less crenellated sutures; the sculpture also has a much more decussate appearance, and the columella is more obliquely truncate, while



being diffused above into a callus, which is not the case with *Itiopiana Meneleki*. In the only specimens which I have seen the outer lip is broken, but I think that there is no doubt that when intact it is single and acute.

SUBULINA (ITIOPIANA) NYMPHA, n.sp.

Shell differing from the two preceding species in its smaller size and more slender and graceful form; it possesses but $10\frac{1}{2}$ whorls, and



the sutures are margined. Alt. 18, diam. maj. 4 mm.; aperture, alt. 3.75, diam. 1.5 mm.

LIMNÆA AFRICANA, Rüpp.

A single specimen having the following dimensions: alt. 17.75, diam. maj. 10.5, min. 7.75; aperture, alt. 13, diam. 6.75.

A REVISION OF THE SPECIES OF THE FAMILY PYRAMIDELLIDÆ
OCCURRING IN THE PERSIAN GULF, GULF OF OMAN, AND
NORTH ARABIAN SEA, AS EXEMPLIFIED MOSTLY IN THE
COLLECTIONS MADE BY MR. F. W. TOWNSEND (1893-1900),
WITH DESCRIPTIONS OF NEW SPECIES.

By JAMES COSMO MELVILL, M.A., D.Sc.

Read 10th June, 1910.

PLATES IV-VI.

It was in 1901¹ that, in collaboration with Mr. R. Standen, I first essayed a catalogue of the Gastropoda of the Persian Gulf and contiguous seas, including, of course, the family a revision of which is the cause of this paper. During the period of over nine years which has elapsed since its publication, a large amount of most valuable and distinguished work amongst the molluscan products of the deep sea has been accomplished; the citing of four or five names amply bear witness to this, e.g., Mr. Charles Hedley on the Australian fauna, Dr. M. M. Schepman on the results of the "Siboga" Expedition to the East Indies, Mons. Ph. Dautzenberg & Fischer² on the Mollusca of Annam, Dr. Sturany on Erythræan species, and Dr. W. H. Dall & Mr. Paul Bartsch, recently having given special attention to this family, have published two papers of extreme importance, viz., (1) "A Monograph of West American Pyramidellid Molluscs",³ (2) "Notes on Japanese, Indo-Pacific, and American Pyramidellidæ".⁴ In the first-mentioned treatise about 300 or more species are catalogued, nearly two-thirds of which are new to science, while a more complete subgeneric classification of, especially, the genera *Turbonilla* and *Odostomia* has been essayed. In the latter the chief feature is the figuring, for the first time, of several of Dr. Arthur Adams' Japanese and North Chinese shells of this group.

The student of this fascinating but difficult subject owes an especial meed of gratitude to these authors for having to some extent thrown an effective searchlight over the insufficiently described and unfigured species, without measurements, without detail, which were so profusely given to the world in the early sixties, during Dr. Adams' visit to the East. These papers mainly appeared during the four years 1860-3 inclusive, in the pages of the *Annals and Magazine of Natural History*. It is true the author fixed upon no actual types, and consequently in many instances one can never be quite sure whether the labelling be correct, and whether such specimens should be accepted as the true exponents of the describer's diagnoses.

¹ Proc. Zool. Soc. Lond., 1901, pp. 327-460, pls. xxi-xxiv.

² Journ. de Conch., vol. liv, pp. 179-99, 1907.

³ Smithsonian Inst., U.S. Nat. Mus., Bulletin 68, pp. 1-258, 1909.

⁴ Proc. U.S. Nat. Mus., No. 1452, vol. xxx, pp. 321-69, pls. xvii-xxvi, Washington, 1906.

Accordingly the solution of a few of the more tangible species is much to be commended, which, by being well figured and often redescribed, though still, of course, retaining the Adamsian 'cognomina', are thus raised upon a higher platform, and cease to be such severe stumbling-blocks to the student as heretofore. We wish it were possible to place all this author's deep-sea species—between five and six hundred is the total of mostly minute shells—upon as satisfactory a basis.

The affinities of the Persian Gulf and Arabian Sea Pyramidellidæ lie, as might be expected, with those of the Erythræan fauna, while many very similar, but always to be differentiated, exist in the Mediterranean.

In a paper published lately¹ it was found by a tabular comparison that, of 475 species of Mollusca collected during the Stanley Gardiner Expedition in the Amirantes, Seychelles, Cargados, and Chagos Archipelago, all in the South Indian Ocean, but little more than a quarter were known to exist in the Persian Gulf. It has long been my theory that the course of the currents, coupled with the geographical configuration, tend in making the gulf a 'cul-de-sac', and thus the creation of endemic forms is favoured. The exceptionally prolific dredging made at 156 fathoms in the Gulf of Oman in 1903 was not only memorable for the vast amount of new minute forms of shells, for Prof. Sydney J. Hickson, F.R.S., is describing this year a new genus and species (*Pyrophyllia inflata*) of solitary Octoradiæ Corals from this locality, and several other similar organisms await differentiation. Many of the fishes, too, procured by Mr. Townsend in the immediate neighbourhood proved new to science.

In the following catalogue I have to some extent adopted the sequence of species as given in the former list. From motives of convenience, the species are placed in alphabetical order, and I have not ventured to subdivide the *Turbonillæ* into sections. I have considered *Pyrgulina* a proper genus as distinct from *Odostomia*; and under *Syrnola* still retain certain elongate Odostomoid forms which some authors would perhaps place in the latter genus. Of six or seven species which have been insufficiently figured, I have taken the opportunity of giving more presentable likenesses, which I trust may be useful. It had been thought that the Eulimidæ might be also included in this paper, as completing the Gymnoglossa, but revision does not seem so necessary here: there are but few additions, and fewer new localities to add or comments to make. Accordingly this idea has not been carried into effect.

I would just add that it is well to recapitulate here the lines of demarcation proposed at first for the limitation of the terms 'Persian Gulf' and 'North Arabian Sea'. While the whole of the Gulf and of the Gulf of Oman is included, only that portion of the Arabian Sea is embraced which lies north of an imaginary line running obliquely from Ras-el-Hadd, south-east of Maskat (Muscat), to Panjim on the Indian coast. This includes not only Bombay and Ratnagiri, but also the Angrias Bank.

¹ Trans. Linn. Soc. Lond., Zoology, ser. II, vol. xiii, pt. vi, pp. 65-138, pl. vi, 1909.

The three subdivisions proposed are as follows:—(1) P.G. The whole Persian Gulf, including the Gulf of Oman, with Maskat and Jask, bordered to the east by long. $59^{\circ} 48'$ E. (2) M.C. The Mekran Coast of Persia and Baluchistan, between long. $59^{\circ} 58'$ E. and the River Hab. (3) I. The coast of Continental India, from east of River Hab, abutting on Karachi, say long. $66^{\circ} 40'$ E., south-east to Panjim, lat. $15^{\circ} 50'$ N., long. 74° E.

In conclusion, I am indebted, now as on many previous occasions, to Mr. Edgar A. Smith, I.S.O., and Mr. Ernest Ruthven Sykes, F.L.S., for aid in the requisite researches. To Mr. Lionel E. Adams I owe perennial gratitude for having, now some time ago, presented me with the series that his uncle, Dr. A. Adams, had retained for his own collection of the Mollusca dredged by him in Japan, which consisted of about 200 to 250 species, accompanied with copies of reprints of all his descriptions. Although a very large proportion of these are unnamed, the collection is of much service in showing the various Far Eastern forms, and with its aid, coupled with those from the same source in the British Museum, I have made many comparisons amongst the Pyramidellidæ.

The great majority of specimens were collected by Mr. F. W. Townsend, but a few were found by Mr. Alexander Abercrombie at Bombay.

Sect. *Gymnoglossa*.

Family PYRAMIDELLIDÆ.

PYRAMIDELLA DOLABRATA (Linn.), var. *TEREBELLOIDES*, A. Adams, sp.

Obeliscus terebelloides, A. Adams: Sowerby, Thes. Conch., vol. iii, p. 808, pl. clxxi, fig. 18, 1855.

Pyramidella dolabrata, Linn., var. *terebelloides*, A. Adams: Tryon, Man. Conch., vol. viii, p. 300, pl. lxxii, fig. 74, 1886.

Hab.—M.C. Charbar, 3–5 fathoms, sand.

I. Karachi, lat. $26^{\circ} 55'$ N., long. $57^{\circ} 59'$ E., 37 fathoms.

PYRAMIDELLA PULCHELLA, A. Adams.

Pyramidella pulchella, A. Adams: Sowerby, Thes. Conch., vol. iii, p. 808, pl. clxxi, fig. 20, 1855.

Hab.—P.G. Kishm Island, 6 fathoms, mud.

M.C. Charbar.

I. Bombay (Abercrombie).

By some authors this is considered a *Syrnola*, but the columellar plicæ are two in number.

PYRAMIDELLA (LONCHÆUS) MACULOSA, Lamarek.

Pyramidella maculosa, Lamarek, Ency. Méth., pl. 452, figs. 1a, b.

Hab.—P.G. Off Shaikh Shuaib Island, 7 fathoms, sand, mud, and stones.

I. Karachi.

Tryon (Man. Conch., vol. viii, p. 301) considers *maculosa* and *acus*, Gmel., identical.

PYRAMIDELLA (LONCHÆUS) SULCATA, A. Adams.

Pyramidella sulcata, A. Adams: Sowerby, Thes. Conch., vol. ii, p. 807, pl. clxxi, fig. 34.

Hab.—Henjam Island.

Maskat (Muscat), 10–15 fathoms, loose stones and muddy sand.

PYRAMIDELLA (OTOPLEURA) MITRALIS, A. Adams.

Pyramidella mitralis, A. Adams, Proc. Zool. Soc., 1853, p. 177.

Hab.—P.G. Kais (or Gais) Island, 5–10 fathoms, coral sand.

M.C. Charbar. Dead specimens.

PYRAMIDELLA (OTOPLEURA) PROPINQUA, A. Adams.

Pyramidella propinqua, A. Adams: Sowerby, Proc. Zool. Soc. Lond., 1853, p. 177; Reeve, Conch. Icon., *Pyramidella*, fig. 22.

Hab.—P.G.; M.C.; I., Karachi.

SYRNOLA AMBAGIOSA, Melvill.

Syrnola ambagiosa, Melvill, Proc. Malac. Soc., vol. vi, p. 55, pl. v, fig. 12.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58'$ N., long. $58^{\circ} 54'$ E., 150 fathoms.

A curious shell of sinuous contour, with remarkably blunt and conspicuous heterostrophe nuclear whorls, the opaque internal spiral lineations very marked likewise. It has no ally in this fauna.

SYRNOLA APERANTA, Melvill.

Syrnola aperanta, Melvill, Proc. Malac. Soc., vol. vii, p. 73, pl. vii, figs. 9, 10.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58'$ N., long. $56^{\circ} 54'$ E., 156 fathoms, shell-sand.

With much of the outward appearance of *Eulimella*, especially *E. carmanica*, Melvill.

SYRNOLA BRUNNEA (A. Adams).

Obeliscus brunneus, A. Adams: Sowerby, Thes. Conch., vol. ii, p. 810, pl. clxxi, fig. 35.

Syrnola brunnea, A. Adams, Proc. Zool. Soc., 1862, p. 233.

Hab.—I. Karachi. Rarely.

SYRNOLA CINCTELLA, A. Adams.

Syrnola cinctella, A. Adams, Ann. Mag. Nat. Hist., vol. vi, p. 333, 1860.

Hab.—P.G. Kishm Island, 6 fathoms, mud.

M.C. Charbar.

I. Karachi.

A well-known species of wide distribution. It is reported from Queensland by Hedley.

SYRNOLA CLAVELLOSA, Melvill.

Syrnola clavellosa, Melvill, Proc. Malac. Soc., vol. vii, p. 73, pl. vii, figs. 9, 10.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

Distinguished by its club-like form, with remarkably large, obtuse, heterostrophe apex.

SYRNOLA CLEARETE, n.sp. Pl. IV, Fig. 1.

S. testa conico-elongata, supra permultum attenuata, caudata, solidiuscula, nitida, anfractibus 10–12, quorum apicales duo planorbuli, subpellucidi, heterostrophici, cæteris apud suturas inciso-canaliculatis, imprimis tarde accrescentibus, ultimo infra peripheriam paulum abbreviato, spiraliter unizonato, zona obscura, rufa, in uno specimine omnino absente, superficie sub lente omni minutissime striatula, apertura subrotunda, labro constricto, columella 1-plicata. Long. 8, lat. 2.50 mm.

Hab.—Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

A caudate, *Pyramidella*-like species, with incised canaliculate sutures, solid substance, and attenuate upper whorls. The columella, however, is but once-plaited. Some examples possess a narrow spiral obscure rufous zone round the whorls, in others it is quite absent.

SYRNOLA ELEGANS, A. Adams.

Syrnola elegans, A. Adams: Sowerby, Thes. Conch., vol. ii, p. 808, pl. clxxi, fig. 19.

Hab.—M.C. Charbar.

I. Karachi. Dredged amongst muddy sand and shingle, 7 fathoms.

This pretty species occurs at Singapore and in the Philippines, and is evidently of wide distribution throughout the Eastern tropics.

SYRNOLA KARACHIENSIS, Melvill. Pl. IV, Fig. 2.

Syrnola Karachiensis, Melvill, Mem. Manch. Soc., vol. xli, No. 7, p. 12, pl. vi, fig. 9.

Hab.—P.G. Mussandam.

M.C. Charbar.

I. Karachi. Amongst weed and mud upon rocks at low tide.

A plain, brown species, uniform in appearance, of which the only ally is the much larger *S. brunnea*, A. Adams.

SYRNOLA MEKRANICA, Melvill & Standen.

Syrnola Mekranica, Melvill & Standen, Proc. Zool. Soc., 1901, p. 390, pl. xxii, fig. 21.

Hab.—M.C. Charbar, 7 fathoms.

A graceful white species, with rufous spiral bands. Mr. C. Hedley wrote me not long ago that he had detected a very similar, if not identical, species in Australia.

SYRNOLA METRIA, Melvill.

Syrnola metria, Melvill, Proc. Malac. Soc., vol. ii, p. 112, pl. viii, fig. 16.

Hab.—P.G. Bushire.

I. Karachi. At low tide amongst weed and loose rocks.

A small Pyramidelloid with canaliculate whorls and once-plaited columella. It has only, so far, occurred singly.

SYRNOLA MODICA (A. Adams).

Pyramidella modica, A. Adams: Reeve, Conch. Icon., *Pyramidella*, fig. 41.

Hab.—P.G. Mussandam, 47 fathoms.

M.C. Charbar.

Seems to co-relate nearest with this species, which has its headquarters in Japan. I also have three specimens in my collection labelled Hong-Kong.

SYRNOLA MUSSANDAMICA, Melvill & Standen.

Syrnola mussandamica, Melvill & Standen, Ann. Mag. Nat. Hist., vol. xii, p. 304, fol. xxii, fig. 1, 1903.

Hab.—P.G. Gulf of Oman.

Mussandam, just at the entrance into the Persian Gulf. A beautiful delicate white shell, which perhaps would be considered best relegated to *Styloptygma*, Adams.

STYLOPTYGMA BEATRIX, n.sp. Pl. IV, Fig. 4.

S. testa gracili, attenuato-fusiformi, alba, vitrea, subpellucida, delicata, nitida, anfractibus 12–14, quorum apicales duo heterostrophii, vitrei, cæteris undique arcte et delicatissime spiraliter striatis, in speciminibus pluribus ad medium zonula interna obscura præditis, plerumque subventricosis, præcipue medios apud anfractus, duobus ultimis sæpius rectis, ultimo paullum prolongato, apertura oblongo-ovata, labro paullum effuso, margine columellari, præcipue ad basin, squarrose incrassatulo, columella uniplicata.

Long. 9, lat. 2 mm., sp. maj.

„ 6, „ 1.75 „ min.

Hab.—Persian Gulf, off Mussandam, at 50 fathoms (April, 1910).

Several examples of a delicate, attenuate, graceful shell, pellucid white, twelve or more whorled, of which certain of the centrally situated ones are more or less tumid, two lowest, however, being almost straight. The surface is uniformly most delicately spirally striate; in the centre of the lower whorls especially, an internal sub-pellucid median band is, in certain lights, observable. Allied to *S. typicum*, Tryon, from the Philippines, but in this species the apical whorls are more rapidly contracted, so as to become almost caudate, and a central sulcus is to be found on the body-whorl. Several examples were dredged, all alike save in size.

STYLOPTYGMA COMETES, n.sp. Pl. IV, Fig. 3.

S. testa obscure rimata, cylindrica, superne multum attenuato-caudata, lacteo-vitrea, subpellucida, tenuissima, perfragili, anfractibus ad 13, quorum tres apicales bulbosi, clare vitrei, his septem proximis, apud suturas anguste sulcatis, fere rectis, tribus ultimis ventricosulis, omnibus omnino lævibus, apertura parva, subrotunda, labro tenui, columella uniplicata. Long. 6, lat. 1.50 mm.

Hab.—Karachi.

A very delicate and fragile shell; indeed, while the type was being examined microscopically it was broken, the opportunity, however, being then taken to examine the internal columellar arrangement, it was found to be strongly once-plaited almost to the apex. The seven mid-whorls are almost straight and uniform, the three lowest ventricose and impressed suturally.

ACTÆOPYRAMIS AMÆNA (A. Adams).

Monoptygma amæna, A. Adams, Proc. Zool. Soc., 1851, p. 223.

Leucotina amæna, A. Adams: Melvill & Standen, Proc. Zool. Soc., 1901, p. 452.

Actæopyramis amæna, Tryon, Man. Conch., vol. viii, p. 312, pl. lxxiv, fig. 41.

Hab.—P.G. and M.C. No exact record.

I. Bombay (Abercrombie).

It is often difficult to differentiate generically between *Leucotina* and *Actæopyramis*. I still think *Leucotina Jaskensis*, Melvill, from the Gulf of Oman, of that genus; but now transfer here, with some hesitation, one or two other species.

ACTÆOPYRAMIS CASTA (A. Adams).

Chrysallida casta, A. Adams, Ann. Mag. Nat. Hist., vol. viii, p. 301, 1861.

Actæopyramis casta (A. Adams), Tryon, Man. Conch., vol. viii, p. 314, pl. lxxiv, fig. 45.

Hab.—P.G. Bahrein Is.

I. Karachi. Amongst weed, mud, and loose stones at low tide.

Bombay (Abercrombie).

ACTÆOPYRAMIS FULVA (A. Adams).

Monoptygma fulva, A. Adams, Proc. Zool. Soc., 1851, p. 222.

Actæopyramis fulva (A. Adams), Tryon, Man. Conch., vol. viii, p. 313, pl. lxxiv, fig. 42.

Hab.—I. Bombay (Abercrombie).

Karachi. Amongst dredged shingle. Dead specimens only, but in very fine condition.

ACTÆOPYRAMIS GAVISA (Melvill).

Myonia gavis, Melvill, Proc. Malac. Soc., vol. ii, p. 112, pl. viii, fig. 26.

Hab.—I. Bombay (Abercrombie).

This may, perhaps, be a *Leucotina*. The type is not in very first-class condition.

ACTÆOPYRAMIS GRATIOSA (Melvill).

Leucotina gratiosa, Melvill, Mem. Manch. Soc., vol. xlii, pt. ii, p. 7, pl. ii, fig. 15.

Hab.—P.G. Off Shaikh Shuaib Island, 10 fathoms, in semi-fossil condition.

I. Karachi; alive, but very rarely found.

A very elegant, delicate species, and I am not even yet quite sure as to its systematic position.

ACTÆOPYRAMIS GRANULATA (A. Adams).

Monopygma granulata, A. Adams, Proc. Zool. Soc., 1851, p. 222.

Hab.—I. Karachi. Only once observed.

ACTÆOPYRAMIS PSYCHE, Melvill.

Actæopyramis Psyche, Melvill, Ann. Mag. Nat. Hist., vol. iv, p. 93, pl. i, fig. 13, 1899.

Hab.—I. Karachi.

A fine, elongate, delicate species.

ACTÆOPYRAMIS SPECIOSA (A. Adams).

Monopygma speciosa, A. Adams, Proc. Zool. Soc., 1851, p. 223.

Hab.—P.G. Linjah Anchorage.

Another beautiful species that might possibly be transferred to *Leucotina* with equal advantage.

AGATHA FILIA (Melvill).

Amathis filia, Melvill, Mem. Manch. Soc., 1893, p. 8, pl. i, fig. 12.

Hab.—I. Bombay (Abercrombie). Rare always; in shell-sand.

Agatha, A. Ad. (representative type *A. australis*, Angas), has precedence of one year over *Amathis*, A. Ad.

AGATHA VESTALIS, n.sp. Pl. IV, Fig. 5.

A. testa attenuata, cylindrica, delicata, tenui, pellucente, albo-lactea, perlævi, anfractibus, duobus apicalibus inclusis, vitreis, paullum bulbosis, cæteris ad suturas anguste inciso-impressis, paullum gradatis, ultimo penultimæ et antepenultimum anfractum exsuperante, paullum prolongato, apertura oblonga, labro tenui, columella oblique uniplicata. Long. 7, lat. 2 mm.

Hab.—Bombay (Abercrombie). Commoner than *A. filia*, but specimens are hardly ever found in perfect condition, owing to their fragility.

A pellucid, milky-white *Agatha*, differing from the other Bombay species (*A. filia*, Melvill) in its marked narrowness of whorl in proportion to its length; in most other particulars, e.g. gradation of whorl, transparent consistency, nuclear whorls, and form of mouth, they are almost identical. Several examples, all alike.

Whether *Amathis* be entitled to rank as a genus on its own merits,

as distinct from *Agatha*, A. Ad., is open to some doubt. And also, whether the species of these genera, with *Myonia*, A. Ad. (in part), are best located here or among the Acteonidæ, is uncertain. In my opinion, despite the very oblique columellar plication, *Agatha*, at all events, is best placed near *Actæopyramis*.

ELUSA BRUNNEOMACULATA, Melvill. Pl. IV, Fig. 6.

Elusa brunneomaculata, Melvill, Mem. Manch. Soc., No. 7, p. 13, pl. vi, fig. 5, 1897.

Hab.—P.G. Dredged in 5 fathoms, sand and mud. Gulf of Oman ; Malcolm Inlet (Kubbatt Ghazira), 24 fathoms.

M.C. Charbar, a few specimens only.

I. Karachi, also rare.

This is a remarkably isolated form, and one of the most select of the order. The curious mahogany-coloured dashes on the pure-white ground are very characteristic, and likewise the firm semi-immersed ribs, and most delicate interstitial spiral striations. I prefer, at the present opportunity, giving *Elusa* and also *Syrnola* generic rank, though perhaps it is more correct to consider them subgeneric only to *Pyramidella* in its wide sense.

ELUSA ENELATA,¹ n.sp. Pl. IV, Fig. 7.

T. testa aciculata, nitidissima, albo-vitrea, tenui, anfractibus 11–12, quorum duo apicales planorbuli, inversim heterostrophii, vitrei, perlæves, cæteris apud suturas impressis, inferis fere rectis, undique longitudinaliter costatis, costis lævibus, crassis, interstitiis lævibus, pellucidis, striis internis spiralibus videndis, costis ultimi anfractus circa novemdecim infra peripheriam evanidis, apertura subrotunda, peristomate incrassato, columella excavata, fortiter uniplicata. Long. 5, lat. 1.25 mm.

Hab.—Bombay (Abercrombie).

For years I have had this species mixed up unaccountably with *Turbonilla terebrina* in my collection. It came from the same locality, and was perhaps overlooked as possibly being the young state of the larger species. But it is exceedingly distinct, the very shining appearance of crystalline delicacy, thick longitudinal smooth ribs, the interstices being likewise smooth, though the spiral internal lines show through in certain lights, so transparent is its substance. Peristome thickened, columella with one strong plait.

ELUSA STRIGILLATA, A. Adams.

Elusa strigillata, A. Adams, Proc. Zool. Soc., 1862, p. 237.

Hab.—P.G. Gulf of Oman, Maskat (Muscat), 15 fathoms.

I. Karachi. Amongst stones and mud at very low tides.

¹ ἐνήλατον, a pin.

ELUSA SUBULATA (A. Adams).

Pyramidella subulata, A. Adams, Proc. Zool. Soc., 1853, p. 177.

Hab.—I. Lat. $18^{\circ} 58' N.$, long. $71^{\circ} 45' E.$, 40 fathoms.

An interesting shell, with caudate, narrow, upper and apical whorls. The type is Japanese. It has lately been discovered off Australian coasts and refigured by Hedley. (Proc. Linn. Soc. N.S.W., 1900, p. 504, pl. xxv, figs. 19–21.)

EULIMELLA ÆÆA, Melvill.

Eulimella ææa, Melvill, Journ. Malac., vol. xi, p. 81, pl. viii, fig. 8.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $54^{\circ} 25' E.$, 156 fathoms.

Conspicuous for its inversely revolute nucleus and remarkably ventricose whorls.

EULIMELLA CARMANICA, Melvill.

Eulimella carmanica, Melvill, Ann. Mag. Nat. Hist., vol. xii, p. 303, pl. xxi, fig. 14, 1903.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

EULIMELLA MAIA, n.sp. Pl. IV, Fig. 8.

E. testa attenuata, fere recta, lævi, nitida, tenui, alba, anfractibus 11, quorum apicales duo planorbuli, heterostrophii, cæteris novem ad suturas leniter impressis, rectis, ultimo ad basin rotundato, anfractibus supernis unifasciatis, ultimo bifasciato, fascia spirali obscura, rufa, apertura ovata, peristomate tenui, columella superficialiter simplice. Long. 6, lat. 1.20 mm.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

Most akin to *E. unifasciata* (Forbes) from New England, the Azores, and also the Mediterranean, of which I have specimens collected during the "Porcupine" Expedition. It differs, however, both in form and texture, and likewise in the double spiral zone on the last whorl, there being, as the name would imply, only one such on *E. unifasciata*.

EULIMELLA GEDROSICA, Melvill.

Eulimella gedrosica, Melvill, Proc. Malac. Soc., vol. vi, p. 55, pl. v, fig. 14.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

A curiously formed little species, with contour somewhat resembling, amongst its congeners, *E. simplex*, Orbigny, or *E. laxa*, Watson. Under a lens it is seen to be very finely microscopically striate. I expect that a separate genus will be found for this, and perhaps *E. ææa* in the course of time, as they differ in so many particulars from the typical species of the genus, of which the next (*Kaisensis*) is a good exponent.

EULIMELLA KAISENSIS, Melvill. Pl. IV, Fig. 9.

Eulimella Kaisensis, Melvill, Mem. Manch. Soc., vol. xlii, No. 4, p. 21, pl. ii, fig. 5.

Hab.—P.G. Near Fao, Bushire; Kishm Island, 6 fathoms, mud; Linjah, $3\frac{1}{2}$ fathoms. The type from Kais (or Gais) Island.

Gulf of Oman, lat. $23^{\circ} 55' N.$, long. $57^{\circ} 48' E.$; lat. $24^{\circ} 5' N.$, long. $77^{\circ} 35' E.$, 205 fathoms. Likewise in the well-known locality at 156 fathoms.

I. lat. $18^{\circ} 58' N.$, long. $71^{\circ} 45' E.$, 40 fathoms. These last are exceedingly fine specimens, the whorls sometimes attaining sixteen in number and all of ivory whiteness, and great symmetrical regularity.

EULIMELLA NITIDISSIMA (Montagu).

Turbo nitidissimus, Montagu, Test. Br., vol. ii, p. 299, pl. xii, fig. 1.

Aclis nitidissima (Montagu), Forbes & Hanley, vol. iii, p. 223, pl. xc, figs. 6, 7.

Anisocyclus nitidissima, Monterosato, Bull. Soc. Malac. Ital., vol. vi, p. 72, 1880.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

I cannot distinguish this from the European shell, and am convinced it is identical. It is found rarely, but generally, round the English, Scotch, and Irish coasts.

EULIMELLA VENUSTA, Melvill.

Eulimella venusta, Melvill, Proc. Malac. Soc., vol. vi, p. 55, pl. v, fig. 14.

Hab.—P.G. Lat. $18^{\circ} 58' N.$, long. $71^{\circ} 45' E.$, 40 fathoms; also at 156 fathoms.

A very graceful species.

MORMULA MACANDREÆ, A. Adams.

Mormula Macandreae, A. Adams, Ann. Mag. Nat. Hist., ser. iv, vol. vi, p. 127.

Hab.—P.G. Lat. $45^{\circ} 55' N.$, long. $57^{\circ} 59' E.$; lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

M.C. Charbar, 7 fathoms, on rocks.

A very delicate species, conspicuous for its large bulbous nuclear whorls, its pronounced varices, and golden-brown hue. The original type came from the Gulf of Suez (R. MacAndrew Coll.).

MORMULA PERSARUM, Melvill & Standen.

Mormula persarum, Melvill & Standen, Ann. Mag. Nat. Hist., vol. xii, p. 304, pl. xxii, fig. 2, 1903.

Hab.—P.G. Gulf of Oman, Maskat (Muscat), at 15 fathoms.

A beautiful and very rare form, allied to the above *M. Macandreae*, A. Ad., but more regular, with fewer and less pronounced varices. Only once dredged hitherto.

MORMULA RISSOINA, A. Adams.

Mormula rissoina, A. Adams, Journ. Linn. Soc. Lond., vol. vii, p. 1.

Hab.—M.C. Rare off coast of Baluchistan.

We have seen this peculiar species from the Andaman Isles (G. Booley Coll.).

TURBONILLA ABERCROMBIEI, Melvill.

Turbonilla Abercrombiei, Melvill, Proc. Malac. Soc., vol. ii, p. 114, pl. viii, fig. 7.

Hab.—I. Bombay (A. Abercrombie).

A small, elegant, somewhat turreted species, many ribbed, the ribs once gemmulate spirally just below the sutures. Interstices smooth. Not yet found by Mr. Townsend, it probably does not range so far north.

TURBONILLA ANGUSTISSIMA, Melvill.

Turbonilla angustissima, Melvill, Proc. Malac. Soc., vol. vi, p. 55, pl. v, fig. 13, 1904.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

The narrowest by far of the Eastern species in proportion to its length. The remarkable inverse heterostrophe apex would seem to place it in the sub-genus *Nisiturris*, Dall & Bartsch. The only difference between this and *T. Gabrieli*,¹ Hedley, from 10 fathoms off the Hope Islands, Queensland, seems to consist in the straight longitudinal ribs of the latter as opposed to the slightly oblique ones of *angustissima*, and we should call them extreme forms of one species.

TURBONILLA BASILICA, Melvill. Pl. IV, Fig. 10.

Turbonilla basilica, Melvill, Mem. Manch. Soc., vol. xlii, No. 4, p. 22, pl. i, fig. 9.

Hab.—P.G. Lat. $27^{\circ} 52'$, 40 fathoms, on Telegraph Cable, Kishm Island, 6 fathoms, mud; Bushire.

One of the rarer forms, the somewhat similar *T. fraterna*, described in this paper, having been confused with it till now. It is somewhat dolioliform, white, small, and shining, smooth at the interstices. *T. sororia* is another ally. The nuclear whorls are not so pronounced as in the last-mentioned, but both might easily be placed as *Nisiturris*.

TURBONILLA CANDIDA, Folin.

Turbonilla candida, de Folin, Fonds de la Mer, p. 207, pl. xxviii, fig. 13.

Hab.—P.G. Kishm Island, 6 fathoms, soft mud.

I. Karachi. Amongst rocks covered at low tide with mud, sand, and weeds.

The largest species. Originally described from West Africa.

¹ C. Hedley, Proc. Linn. Soc. N.S.W., vol. xxxiv, pt. iii, p. 449, pl. xlii, fig. 74, 1909.

TURBONILLA CHARBARENSIS, Melvill & Standen.

Turbonilla (Pyrgostelis) Charbarensis, Melvill & Standen, Proc. Zool. Soc., p. 393, pl. xxii, fig. 22, 1901.

Hab.—M.C. Charbar. Mekran Coast, 7–10 fathoms.

A compact species, rufous-ochre, ribs not very pronounced, striate at the interstices. Allied to *T. rufa*, Philippi, which is the type of the sub-genus *Pyrgiscus*, Phil., in which it should probably be likewise included.

TURBONILLA COLPODES,¹ n.sp. Pl. V, Fig. 14.

T. testa pergracili, multum attenuata, alba, parum nitida, solidiuscula, anfractibus 11–12, quorum apicales heterostrophii, planorbuli, læves, nitidi, cæteris ad suturas impressis, ventricosulis, undique longitudinaliter arctissime costatis, costis crassis, lævibus, oblique flexuosis, ultimum apud anfractum infra peripheriam evanidis, et deinde usque ad basim concentrice sulcato-liratis, interstitiis spiraliter arcte striatis, apertura rotundo-ovata, margine columellari incrassato. Long. 4·50, lat. 1·20 mm.

Hab.—P.G. Off Mussandam, at 50 fathoms; April, 1910.

A small but beautifully sculptured species, of thick substance, proportionately speaking, the longitudinal ribs being obliquely flexuose, with spirally striate interstices; in this latter particular it differs from *T. quæstuosa*, *microporone*, and others possessing oblique riblets, the interstitial spaces being generally smooth in these species.

TURBONILLA DELIA, Melvill.

Turbonilla (Pyrgostelis) Delia, Melvill, Proc. Malac. Soc., vol. vii, p. 73, pl. viii, fig. 30.

Hab.—P.G. Bushire, 6–10 fathoms, very rarely.

Conspicuous for its remarkably ventricose whorls, yellowish hue, and short spire. The shell is smooth, with no interstitial striation.

TURBONILLA EMILIÆ, Melvill.

Turbonilla (Pyrgostelis) Emilia, Melvill, Proc. Malac. Soc., vol. ii, p. 115, pl. viii, fig. 20.

Hab.—I. Bombay (Abercrombie).

A very small species (long. 2, lat. ·075 mm.), with no very leading features. It seems to be of the section *Pyrgiscus*, but shows a leaning towards the genus *Pyrgulina*, in its close ribs and interstitial striation.

TURBONILLA EUCTEANA,² n.sp. Pl. IV, Fig. 11.

T. testa parva, attenuata, gracili, lævissima, pallide straminea, anfractibus 10, quorum duo apicales inversi, læves, vitrei, heterostrophii, cæteris regularibus, ad suturas impressis, haud ventricosis, undique arcte costatis, costis rectis, concinnis, lævibus, sub lente striis spiraliter obscurissimis interstitialiter præditis, costis ultimi anfractus numero

¹ κολπώδης, flexuous, sinuous.

² ευκτέανος, graceful.

18-19 ad basim evanidis, apertura subrotunda, columella fere recta, simplice. Long. 4.50, lat. 1.25 mm.

Hab.—Bombay.

A very neat species, allied to *T. terebrina*, Melvill. Pale ochreous to straw colour, with very smooth and frequent riblets, quite straight and regular. With a powerful lens interstitial striæ are observable, but these are most obscure, and might be easily overlooked. The apical whorls are inversely planorbiform. The general contour of the shell suggests a *Terebra* in miniature. But few examples have occurred in shell-sand.

TURBONILLA EUMENES,¹ n.sp. Pl. IV, Fig. 12.

T. testa minuta, delicata, rimata, attenuato-cylindrica, subpellucida, alba, anfractibus 7, quorum duo apicales heterostrophii, perlæves, depressoplanati, cæteris gradatulis, suturaliter impressis, undique longitudinaliter costulatis, costis fere rectis, lævibus, nitidis, striis interstitialibus arete præditis, numero costarum anfractus ultimi circa viginti, apertura oblongo-ovata, peristomate tenui, columella simplice, paullum obliqua, dein versus basim recta. Long. 3.25, lat. 1 mm.

Hab.—Bombay, in shell-sand (Abercrombie).

A minute and most delicate species, perhaps not quite adult. The shining, smooth ribs, about twenty in number on the body-whorl, stand out prominently under a lens, in contrast with the somewhat coarse striæ, proportionately speaking. The whorls are gradate, nuclear whorls two, smooth, somewhat flattened. Columella simple. I do not know a species similar, unless it be *T. neogila*, also described in this paper, and, though not quite sure of the location, place it with some confidence amongst the *Turbonillæ*, section *Pyrgiscus*, Phil.

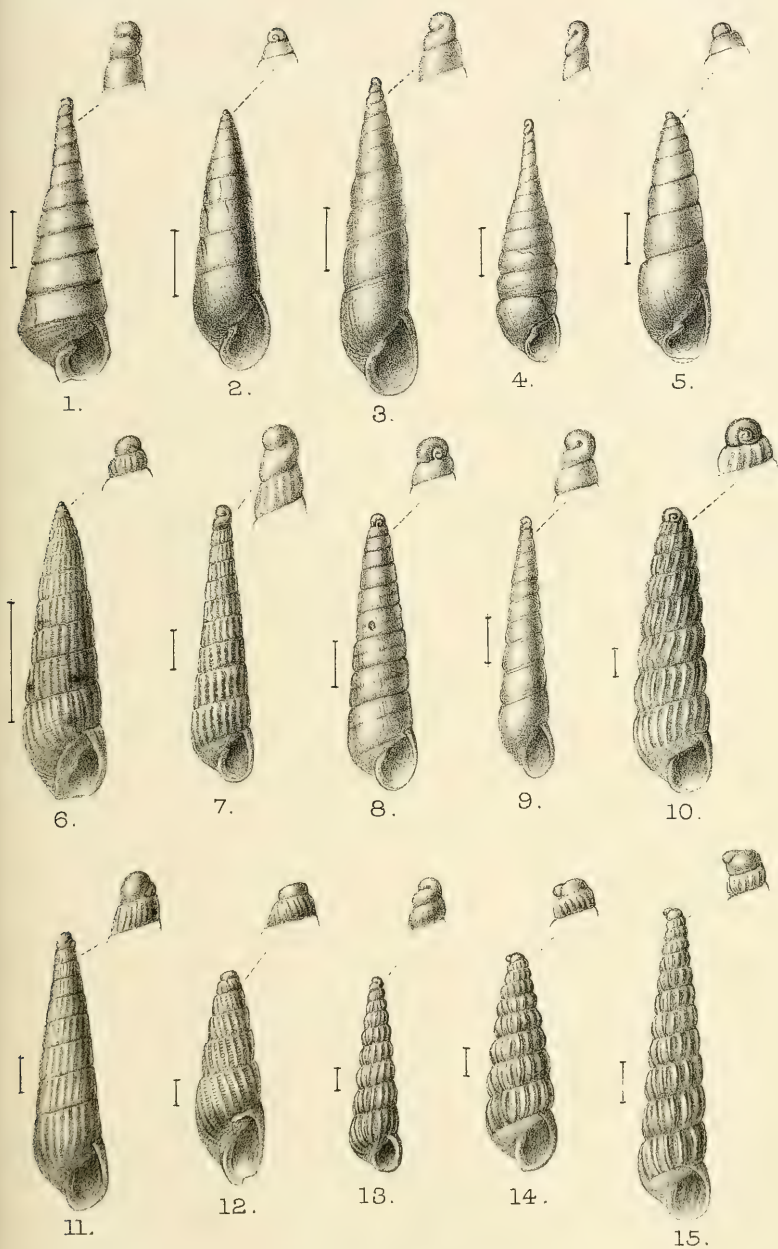
TURBONILLA FRATERNA, n.sp. Pl. IV, Fig. 13.

T. testa aciculata, minuta, angustissima, alba, delicata, anfractibus 10, quorum duo apicales bulbosi, heterostrophii, cæteris ad suturas multum impressis, ventricosulis, undique longitudinaliter lævicostatis, interstitiis lævibus, apertura fere rotunda, peristomate paullum incrassato, columella simplice. Long. 3, lat. .075 mm.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms.

An abundant *Turbonilla* in the above most prolific dredging, but not yet noticed from elsewhere, this little shell was at first considered a variety of *T. basilica*, Melv., which is by no means so graceful a shell, being more cylindrical in form and with different character of ribs. With the exception of *T. angustissima*, it is the narrowest species in proportion to its length known from this region. It is allied to *T. delicata*, Monter., from the South Mediterranean, Algiers, etc.

¹ εὐμένης, acceptable.



A. H. Searle, del et lith.

Huth, imp.

PYRAMIDELLIDÆ FROM THE PERSIAN GULF, ETC.

TURBONILLA GALACTODES,¹ n.sp. Pl. IV, Fig. 14.

T. testa attenuato-conica, gracili, parva, alba, anfractibus 9–10, quorum apicales heterostrophii, planorbuli, læves, cæteris ad suturas impressis, ventricosis, rotundatis, arctissime costatis, costis incrassatis, lævissimis, nitidis, ultimum apud anfractum infra peripheriam ad basim evanidis, interstitiis omnibus lævibus, numero costarum ultimi anfractus circa 28, apertura magna, ovata, peristomate fere continuo, columella simplice. Long. 3·50, lat. 1 mm.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 150 fathoms.

A species not very easy to define as regards its precise limitations. For the type we take a shell with rounded whorls, ornamented with thickened close longitudinal ribs, these ribs fairly straight, the interstices being smooth. Some specimens dredged in live but not mature condition are nearly allied to this, and these were provisionally identified as *T. tenuicosta*, Issel, an Erythræan species, but are distinct. They came from lat. 25° 24' N., long. 57° 27' E., 243 fathoms, sand and mud, and we expect, though the ribs are slightly more flexuose, that they are identical with *T. galactodes*.

TURBONILLA HERMIA, Melvill.

Turbonilla Hermia, Melvill, Proc. Malac. Soc., vol. vii, p. 74, pl. vii, fig. 11.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms.

Allied to *T. Abercrombiei*, *T. Michaelis*, and *T. galactodes*, the last two being described in this paper, this species will be known from all by its compact substance and form, the very fine interstitial striations being another distinguishing characteristic, though this feature is almost, if not quite, obsolete in some specimens. It is locally an extremely abundant species, very closely and somewhat flexuously ribbed, ten or eleven whorled, the nuclear whorls planorbiform, and when once distinguished is easy to recognize.

TURBONILLA ICELA,² n.sp. Pl. IV, Fig. 15.

T. testa parva, aciculata, pergracili, delicata, tenui, pellucente, albo-lactea, anfractibus 10–11, quorum apicales pupæformes, inversim heterostrophii, conspicui, cæteris ad suturas multum impressis, ventricosis, longitudinaliter obliquicostatis, costarum numero anfractus ultimi ad 21, infra peripheriam ad basim evanidis, apertura ovata, peristomate fere continuo, columella simplice. Long. 5·50, lat. 1·20 mm.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms, shell-sand; Bushire.

M.C. Charbar, 40 fathoms.

A very abundant species in the first and last of the above-mentioned localities, and confounded with *T. sororia*, Melv., from Bombay till very recently. Its graceful form, milky-white colour, and very

¹ γαλακτώδης, milky white.

² ἑκελος, like, similar.

pronounced pupiform nuclear whorls distinguish it from its congeners. It evidently belongs to the sub-genus *Nisiturris*, Dall & Bartsch. I am obliged to Mr. Edgar Smith for first calling my attention to the distinctness of this species from *sororia*.

TURBONILLA INÆQUALIS, Melvill.

Turbonilla inæqualis, Melvill, Proc. Malac. Soc., vol. vi, p. 162, pl. x, fig. 10.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms, shell-sand.

Quoting from the original description, this shell exhibits a peculiarity in the presence of pseudo-varices, these being simply unequally effuse longitudinal ribs. The whole surface of the shell is remarkably smooth, white, and shining, the mouth a perfect oval, and the heterostrophe nuclear whorls glassy, globular, and completely reversed. It is a rare species, and we have not seen more than twenty specimens.

TURBONILLA JULIA, n.sp. Pl. V, Fig. 1.

T. testa attenuata, gracillima, solidiuscula, straminea, anfractibus ad 12, quorum apicales 2 heterostrophii, bulbosi, vitrei, cæteris fere rectis, nequaquam tumidis, apud suturas impressis, undique recticostatis, interstitialiter spiraliter rudistriatis, costis crassis, numero ultimum apud anfractum circa 22, infra peripheriam fere evanescentibus, apertura subrotunda, peristomate fere continuo, columella recta, simplice. Long. 6·5, lat. 1·5 mm.

Hab.—Dredged south of Astola Island, 90 fathoms.

A species as yet rarely found, yellowish in hue, with almost straight whorls, and straight, thick, smooth ribs, the interstices being coarsely spirally striate. The species is in general build rather like the larger *T. candida*, Folin, but differs in colour, smaller size, and spiral striation.

TURBONILLA LINJAICA, Melvill & Standen.

Turbonilla Linjaica, Melvill & Standen, Proc. Zool. Soc., pt. ii, p. 393, pl. xxii, fig. 23, 1901.

Hab.—P.G. Linjah, 3½ fathoms, sand.

A very small rufous species, though a few specimens have occurred pure white. The ribs are nearly straight, acute, crowded, interstitially closely striatulate. The whorls are 9–10, with apex bulbous, rufous, impressed at the sutures, and tumescent. It only occurred in one dredging, in December, 1900.

TURBONILLA MANORÆ, Melvill.

Turbonilla (Pyrgostelis) Manoræ, Melvill, Mem. Manch. Soc., vol. xlii, No. 4, p. 23, pl. i, fig. 22.

Pyrgulina Manoræ, Melvill, Ann. Mag. Nat. Hist., vol. xii, pl. xxii, fig. 5, 1903.

Hab.—I. Manora, Karachi.

This so exactly resembles a *Pyrgulina* with a simple columella, however, that I suggested seven years ago its removal to that genus.

I replace it now among the *Turbonillæ*, considering it well harmonizes with the members of the sub-genus *Pyrgiscus*, Phil.

It occurred plentifully in one dredging of Mr. Townsend, but, so far as I am aware, only once. It is eight-whorled, white, delicate, longitudinally straightly ribbed, ribs smooth, interstices finely spirally filostriate, mouth roundly ovate, outer lip slightly effuse, columella straight. It seems nearly allied to *Chrysallida mumia*,¹ A. Adams, from Japan, lately relegated by Dall & Bartsch to the section *Pyrgiscus* of *Turbonilla*.²

TURBONILLA MICHAELIS, n.sp. Pl. V, Fig. 2.

T. testa parva, gracillima, attenuata, nitida, albo-lactea, tenuicula, anfractibus ad 11, quorum duo apicales inversim planorbuli, heterostrophii, cæteris gradatulis, ad medium paullum constrictis, omnino lævissimis, costis crassis, nitidis, supra juxta suturas spiraliter gemmulatis, ultimi anfractus numero 20, apertura ovata, peristomate supra obtuse angulato, fere continuo, columella recta, simplice.

Long. 4, lat. 1.25 mm., sp. maj.

„ 3, „ 1 „ „ min.

Hab.—P.G. Gulf of Oman, lat. 25° 10' N., long. 60° 34' E., 45 fathoms; also lat. 25° 39' N., long. 57° 19' E., 110 fathoms, and the dredging, so often quoted, contiguous to this, at 156 fathoms.

M.C. Off Charbar, 40 fathoms.

A very graceful and beautiful little species, of ornate architecture. In addition to the two inversely heterostrophe nuclear whorls there are nine, elaborately decorated with proportionately thick, smooth, shining ribs, the interstices being likewise smooth. The slight median constriction tends to the gemmulate appearance of the ribs just below the sutures. The peristome is obtusely angled at the upper part, and almost continuous. Columella simple. Named after my grandson, Michael Ernest Melvill.

TURBONILLA MICROPERONE, Melvill.

Turbonilla microperone, Melvill, Proc. Malac. Soc., vol. vi, p. 162, pl. x, fig. 11.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms, shell-sand.

A somewhat incrassate species, to be known from its congeners in these seas by the flexuous, thick, oblique ribs, which are not of a very pronounced character. This species has only rarely occurred.

TURBONILLA NEOGILA,³ n.sp. Pl. V, Fig. 3.

T. testa attenuato-oblonga, nitida, delicata, pallide stramineo-alba, anfractibus 7, quorum 2½ apicales, parvi, vitrei, heterostrophii, cæteris leniter gradatulis, fere rectis, delicate et arcte longitudinaliter striato-costatis, interstitiis tenuiter striatulis, ultimo anfractu prolongato,

¹ Ann. Mag. Nat. Hist., vol. vii, p. 45, 1861.

² Proc. U.S. Nat. Mus., vol. xxx, p. 343, pl. xvii, fig. 1.

³ νεόγυλος, newly introduced.

cæteros magnitudine fere exæquante, costis infra basim continuis, apertura ovata, peristomate tenui, columella simplice. Long. 3.25, lat. 1 mm.

Hab.—Bombay (Abercrombie).

A very delicate little species, very finely longitudinally lirately ribbed, ribs close, interstices also finely striate. Our specimens are slightly beach-worn.

TURBONILLA OLIGOPLEURA,¹ n.sp. Pl. V, Fig. 4.

T. testa fusiformi, pellucida, albo-cornea, delicatula, lævi, anfractibus ad 8, quorum apicalis parvus, heterostrophus, cæteris ad suturas multum impressis, gradatulis, ad medium anfractuum paullum constrictis, undique paucicostatis, costis rectis, superne, spiraliter gemmulatis, ultimo anfractu fere evanidis, præcipue prope aperturam, apertura ovata, labro tenui, columella paullum incrassata, recta, simplice. Long. 5, lat. 1.75 mm.

Hab.—P.G. Gulf of Oman, 198 fathoms, dredged alive, in various stages of growth.

An abbreviate form, thin, horny, white, that may not have attained a perfectly adult stage. It is conspicuous for its few ribs; around the last whorl there are not more than 14–15, and some of these are partly evanescent. We figure the most mature example; nine or ten others are smaller, and do not possess more than five whorls. In all, the nuclear whorls are somewhat small, globular, smooth, and white. We had in error supposed this to be *T. Vélaini*, Tryon = *scalaris*, Vélain, from St. Paul's Rocks.

TURBONILLA PACHYPLEURA,² n.sp. Pl. V, Fig. 5.

T. testa mediocri, incrassata, aciculato-attenuata, alba, rudi, anfractibus 12, quorum apicales duo vel tres reversi, heterostrophii, cæteris multum ad suturas impressis, tumidulis, undique lævicostatis, costis crassis, interdum varicosis, interstitiis lævibus, quarto, quinto, et sexto anfractibus arcissime costatis, ultimo infra peripheriam angulato, lævi, 15 costato, apertura ovata, peristomate incrassato, columella recta. Long. 8, lat. 2 mm.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms.

One of the large and coarse species, quite smooth, twelve-whorled, including two or three nuclear, heterostrophe, and pupiform, the whorls are tumid, ribs thick, occasionally varixed, mouth oval, lip thickened, columella straight. It but rarely occurred in the above dredging.

TURBONILLA PHYLIDIS, n.sp. Pl. V, Fig. 6.

T. testa pro genere conspicua, attenuata, pergracili, lævissima, candida, delicatula, anfractibus 16, quorum duo nucleares erecti, heterostrophii, bulbosi, vitrei, cæteris arcite longitudinaliter costulatis,

¹ ὀλιγοπλεῦρος, few ribbed.

² παχυπλεῦρος, thick-ribbed.

costis rectis, nitidis simul ac interstitiis lævissimis apud suturas, impressis, haud ventricosis, interne arcte spiraliter lacteo-zonulatis, ultimo anfractu costis infra medium evanidis basi lævi, apertura ovata, peristomate paullum incrassato, columella recta. Long. 10, lat. 2 mm.

Hab.—P.G. Gulf of Oman, lat. $25^{\circ} 13' N.$, long. $58^{\circ} 40' E.$, 120 fathoms.

One of the most graceful and beautiful of the Eastern *Turbonillæ*. The shell, unique at the present time, is without a flaw, and with its many whorls straitly ascending in regular series, the pellucid interstices reflecting the internal spiral striation presents an exquisite example of perfect symmetry.

TURBONILLA PUNCTILLUM,¹ n.sp. Pl. V, Fig. 7.

T. testa parva, aciculata, delicata, albo-ochracea, anfractibus $9\frac{1}{2}$, quorum $2\frac{1}{2}$ nucleares, bulbosi, heterostrophii, planorbuli, cæteris ad suturas impressis, subventricosis, lævibus, undique longitudinaliter costulatis, costis flexuosis, tenuibus, supra, juxta suturas spiraliter et regulariter interstitialiter profunde punctatis, ad ultimum numero costarum circa 21, ad basim lævem, apertura parva, subrotunda, peristomate fere continuo, tenui, columella recta. Long. 4, lat. 1 mm.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

Only one or two examples have occurred of this distinct species, very small, with thin flexuous longitudinal ribs, interstices smooth, but spirally punctate above, near the sutures, in one regular line throughout the whorls. The nucleus is bulbous, vitreous, and planorbiform.

TURBONILLA QUÆSTUOSA, n.sp. Pl. V, Fig. 8.

T. testa parva, aciculata, delicata, albo-lactea, subpellucida, tenui, lævi, anfractibus 9, duobus apicalibus parvis heterostrophis, cæteris ad suturas impressis, gradatulis, paullum tumidulis, undique obliquicostatis, costis anfractus ultimi flexuosis, versus basim fere vel omnino evanidis, apertura ovata, peristomate tenui, columella excavata. Long. 4, lat. 1 mm.

Hab.—Bombay (Abercrombie).

A delicate, thin *Turbonilla*, with oblique longitudinal costæ, which are flexuous on the body-whorl, and become almost in parts evanescent near the base. The whorls are impressed suturally, and shouldered. One interesting character consists in the costæ of the upper whorls ceasing a little way from the suture, leaving a narrow, smooth space. The shell is semi-transparent, milky white, and quite smooth, the surface being dull, and not shining as is so usual a character in the genus. From *T. tenuicosta*, Melvill, an Erythræan species, it would seem to differ in possessing nine whorls against six and a half, dulness against shining appearance, and other minor differences exist.

¹ *Punctillum*, a little dot.

TURBONILLA RECTICOSTATA, Melvill.

Turbonilla recticostata, Melvill, Proc. Malac. Soc., vol. vi, p. 163, pl. x, fig. 12.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

M.C. Charba, 40 fathoms.

A miniature of *T. candida*, Folin; the whorls are very slightly turreted, ribs straight and not many in number, 15 to 16 on the body-whorl. It is not one of the commoner species in the above dredgings.

TURBONILLA SORORIA, Melvill.

Turbonilla sororia, Melvill, Proc. Malac. Soc., vol. ii, p. 114, pl. viii, fig. 17.

Hab.—I. Bombay (Abercrombie).

A whitish-ochre species, twelve or thirteen whorled, sub-pellucid, with ventricose whorls, straightly longitudinally costate, and with smooth interstices, ribs few in number, about twelve on body-whorl. The nuclear whorls are pupiform and expanded, so that it should be placed in the sub-genus *Nisiturris*, D. & B. I had considered *T. icela* the same species, and am obliged for Mr. Edgar Smith's opinion in this matter. All the localities given by me in a subsequent paper¹ should be removed, therefore, with the exception of Bombay, to which locality this species is at present confined. It appears, however, to be the commonest form found there.

TURBONILLA STEGASTRIS, Melvill.

Turbonilla stegastris, Melvill, Proc. Zool. Soc., 1901, p. 393, pl. xxii, fig. 24.

Hab.—P.G. Gais (or Kais) Island.

I. Karachi.

A graceful shell, among the larger of the genus (long. 11, lat. 2.30 mm. sp. maj.), with many fine longitudinal riblets, spirally, as it were, interwoven with cross-threads, while just above the sutures runs one rufous thin spiral line. Whorls nine altogether.

TURBONILLA SYKESII, n.sp. Pl. V, Fig. 9.

T. testa minuta, conico-attenuata, delicata, nitida, alba, lævi, crystallina, anfractibus 9, quorum duo apicales reversi, læves, cæteris anguste ad suturas impressis, supra angulatis, undique arctissime lævicostulatis, costis rectis, interstitiis lævibus, ultimi anfractus flexuosis, infra medium evanidis, ad basim lævissime, apertura ovata, peristomate tenui, fere continuo, columella recta. Long. 2.75, lat. 1 mm.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' E.$, long. $56^{\circ} 54' N.$, 156 fathoms; lat. $25^{\circ} 10' E.$, long. $60^{\circ} 34' N.$; off Charbar, 40 fathoms.

¹ Proc. Zool. Soc., 1901, p. 393.

Allied to *T. galactodes* and *T. Abercrombiei*, Melvill. One of the smaller species, but the elegance of its shining close whorls, subangled at the upper part, just by the sutures, aid in identifying it. Mr. E. R. Sykes kindly assisted me in the differentiation of this and other species, and I have pleasure in connecting this with his name.

TURBONILLA TEMPLARIS, Melvill. Pl. V, Fig. 10.

Turbonilla (Pyrgostelis) templaris, Melvill, Mem. Manch. Soc., vol. xlii, No. 4, p. 23, pl. i, fig. 6.

Hab.—P.G. Mussandam.

M.C. Charbar and Jask.

I. Karachi; Bombay (Abercrombie).

Slightly allied in form, but not in texture, to *T. scalaris*, Philippi, from the Mediterranean, this pretty species is one of the most marked of the Indian *Turbonillæ*, its gradate and tapering crystalline whorls, with straight smooth ribs and equally smooth interstices, being noteworthy. It is widely distributed, but so far has not been found at a greater depth than 10–15 fathoms. A variety occurs, with broader contour, wider mouth, and fewer longitudinal ribs, these being regularly gemmulate above, just below the sutures. These come from Bombay.

TURBONILLA TEREBRINA, Melvill.

Turbonilla terebrina, Melvill, Proc. Malac. Soc., vol. ii, p. 115, pl. viii, fig. 20.

Hab.—P.G. Gulf of Oman, 250 fathoms.

I. Karachi, amongst muddy rocks at low tide.

Bombay (Abercrombie).

A somewhat solid, shining shell, measuring 6 mm. longitudinally, the ribs smoothly rounded and interstices quite smooth, mouth oblong. Very like one of the genus *Terebra* in miniature. It appears fairly generally distributed, but never in much plenty or gregarious as are *icela*, *templaris*, and other species. Originally described from Bombay specimens.

TURBONILLA TOWNSENDI, n.sp. Pl. V, Fig. 11.

T. testa attenuata, ad basim latiore, alba, nitida, anfractibus $10\frac{1}{2}$, *quorum* $2\frac{1}{2}$ *apicales valde bullati, pupiformes, heterostrophæ, cæteris octo ventricosis, ad suturas impressis, undique longitudinaliter costatis, costis nitidis, lævibus, fere rectis, interdum, sed raro, varicosis, costis numero anfractus ultimi 18, undique interstitialiter arcte spiraliter liratis, apud basim, infra peripheriam, omnino evanidis, basi lævi, apertura quadrato-ovata, labro tenui, columella fere recta. Long. 6, lat. 1.75 mm.*

Hab.—Gulf of Oman. M.C. Off Charbar, 44 fathoms.

Distinguished by its somewhat broad base, being 10–11 whorled, of which the nuclear are much inflated, smooth, milky-vitreous, the coils reversedly turned over, the eight principal whorls being homogeneous, impressed suturally, somewhat ventricose, straightly longitudinally ribbed. The ribs are fine, shining, smooth, with the interstices

uniformly closely striolate, mouth squarely oval, columella straight, base plain, smooth. Named in honour of Mr. Frederick W. Townsend.

TURBONILLA UNICINCTA, n.sp. Pl. V, Fig. 12.

T. testa aciculata, gracillima, angusta, delicata, alba, anfractibus ad 13, quorum $2\frac{1}{2}$ apicales bulbosi, planorbuli, heterostrophii, cæteris ad suturas multum impressis, ventricosis, longitudinaliter ante obliquicostatis, interstitiis microscopice spiraliter delicatissime striatulis, ultimi costis numero ad 32, trans basim extensis, ad medium trium anfractuum ultimorum læte et anguste zona rufo-brunnea decoratis, apertura rotunda, peristomate tenui, columella paullum excavata. Long. 5.50, lat. 1.25 mm.

Hab.—M.C. Off Charbar, 40 fathoms.

A very select, delicate, and graceful species, of which we have seen only one, but very perfect example. It is white, thin, attenuate, the heterostrophe nuclear whorls smooth, bulbous, turned over at right angles, the rest being ventricose, very closely obliquely ribbed, the interstices microscopically finely striate. The three lowest whorls are narrowly banded with a thin rufous brown zone in the centre.

TURBONILLA ZETEMIA,¹ n.sp. Pl. V, Fig. 13.

T. testa multum attenuata, parva, rudi, pallide straminea, anfractibus 11, quorum $2\frac{1}{2}$ nucleares planorbuli, heterostrophii, vitrei, tumiduli, cæteris ad suturas impressis, ventricosulis, undique longitudinaliter costatis, costis rudibus, lævibus, nitidis, incrassatis, numero anfractum apud ultimum circa 14, hic illic crassi-varicosis, interstitiis spiraliter striatis, apertura parva, subrotunda, labro paullum crassiusculo, basi lævigata, columella recta. Long. 5, lat. 1 mm.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

A small species, of which we have seen but very few specimens, and none of them in good condition. Its principal characteristics are the few but coarse incrassate ribs, with interstitial—also rather coarse striation; a few varices are likewise found here and there. The base is smooth, mouth small, peristome slightly thickened. *T. Townsendi* is of the same character but a much stouter and broader shell, and *T. pachypleura* may be compared.

N.B. Several other *Turbonillæ* live in these seas, judging from various insufficient fragments that have occurred in shell-sand and other dredgings, and it is probable that but a tithe of the number that exist have been catalogued at the present opportunity.

MUMIOLA CARBASEA, Melvill.

Mumiola carbacea, Melvill, Journ. Malac., vol. xi, p. 83, pl. viii, fig. 12.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms.

Like *M. spirata*, Ad., in miniature, but of thinner, papyraceous texture.

¹ ζήτημα, a thing sought out.

MUMIOLA EPIBATHRA, Melvill.

Mumiola epibathra, Melvill, Proc. Malac. Soc., vol. vii, p. 72, pl. vii, fig. 5.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

The flattened base of this unique shell is somewhat peculiar. The mouth is likewise proportionately small, and the whorls very markedly gradate. It may possibly be ultimately relegated to the *Pyrgiscus* section of *Turbonilla*, but, though somewhat anomalous, we think it bears an affinity to *M. spirata*, Ad.

MUMIOLA SPIRATA (A. Adams).

Parthenia spirata, A. Adams, Ann. Mag. Nat. Hist., vol. vi, p. 414, 1860.

Monoptygma spirata (A. Adams), Sowerby, Thes. Conch., pl. clxxii, figs. 26, 27.

Hab.—P.G. Bushire, Mussandam.

M.C. Charbar, Gwadûr, Ormara.

I. Karachi.

The type of the genus, and not usually showing much variation, but a very elongate form, with one or two more whorls, and narrower proportionately, was dredged off Mussandam. These specimens have an olivaceous epidermis, and may perhaps be distinct.

CINGULINA ARCHIMEDEA, Melvill.

Cingulina archimedeæ, Melvill, Proc. Malac. Soc., vol. ii, p. 115, pl. viii, fig. 2.

Hab.—I. Bombay (Abercrombie).

Since the original description was written, fourteen years ago, I have been shown by Mr. Abercrombie a great many examples, some measuring alt. 8.75, diam. 2 mm., thus much surpassing the type in magnitude. In all other respects the shells are the same.

CINGULINA ISSELI (Tryon).

Turbonilla (Cingulina) Isseli, Tryon, Man. Conch., vol. viii, p. 339, pl. lxxvi, fig. 64.

Eulimella cingulata, Issel, Conch. Mar. Ross., p. 182 (*non* Dunker).

Hab.—P.G. Henjam Island, Dabai, Muscat, etc.

M.C. Charbar, most abundant.

I. Karachi, Manora Point. Found upon muddy weed-covered rocks at low water, and at 7 fathoms.

A somewhat protean species, and one which requires further study than it has yet received.

I am not sure that the true *C. spina*,¹ Crosse & Fisch., occurs in these seas. The only examples I have come from Australia. It was reported by Mr. Townsend from Karachi, but I have not seen specimens.

¹ Journ. de Conch., 1864, p. 347; id., 1865, p. 44, pl. iii, figs. 13, 14.

OSCILLA FACETA, Melvill.

Oscilla faceta, Melvill, Journ. Malac., vol. xi, p. 82, pl. viii, fig. 10, 1904.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

OSCILLA EVANIDA, n.sp. Pl. V, Fig. 15.

O. testa parva, fusiformi, anguste umbilicata, albocinerea, anfractibus 8, quorum duo apicales depressi, fere immersi, cæteris apud suturas impressis, quinque supernis duabus obtusis carinis præditis, ultimo simili modo sed obscure bicarinato, deinde versus basim evanido, apertura ovata, labro tenui, columella fortiter uniplicata. Long. 3.50, lat. 1.75 mm.

Hab.—Karachi.

A somewhat aberrant *Oscilla*, but I am at a loss where otherwise to place it. The two apical whorls are somewhat depressed and inconspicuous, the five next in order uniformly bicarinate, the keels very conspicuous; the body-whorl is more obscurely keeled, but becomes almost smooth ultimately towards the base, and from this circumstance the trivial name has been suggested. *O. mirabilis*, Preston, from Ceylon, a more acutely keeled species, is akin to *O. evanida*.

OSCILLA INDICA, Melvill.

Oscilla indica, Melvill, Proc. Malac. Soc., vol. ii, p. 112, pl. viii, fig. 5.

Hab.—M.C. Charbar, 40 fathoms.

I. Bombay (Abercrombie); Karachi.

Not an uncommon species in these seas, almost always occurring in company with the similar *Irawadia trochlearis*, Blauf., as well as with *O. tornata*. It has been found at Aden by Commander E. R. Shopland.

OSCILLA JOCOSA, Melvill.

Oscilla jocosa, Melvill, Journ. Malac., vol. xi, p. 82, pl. viii, fig. 11; Dautzenberg & Fischer, Journ. de Conch., vol. liv, p. 181, pl. vii, figs. 6, 7, 1907.

Occurred with *O. faceta*, both being of uncommon occurrence.

OSCILLA TORNATA, Melvill.

Oscilla tornata, Melvill, Mem. Manch. Soc., 1893, p. 8, pl. i, fig. 12.

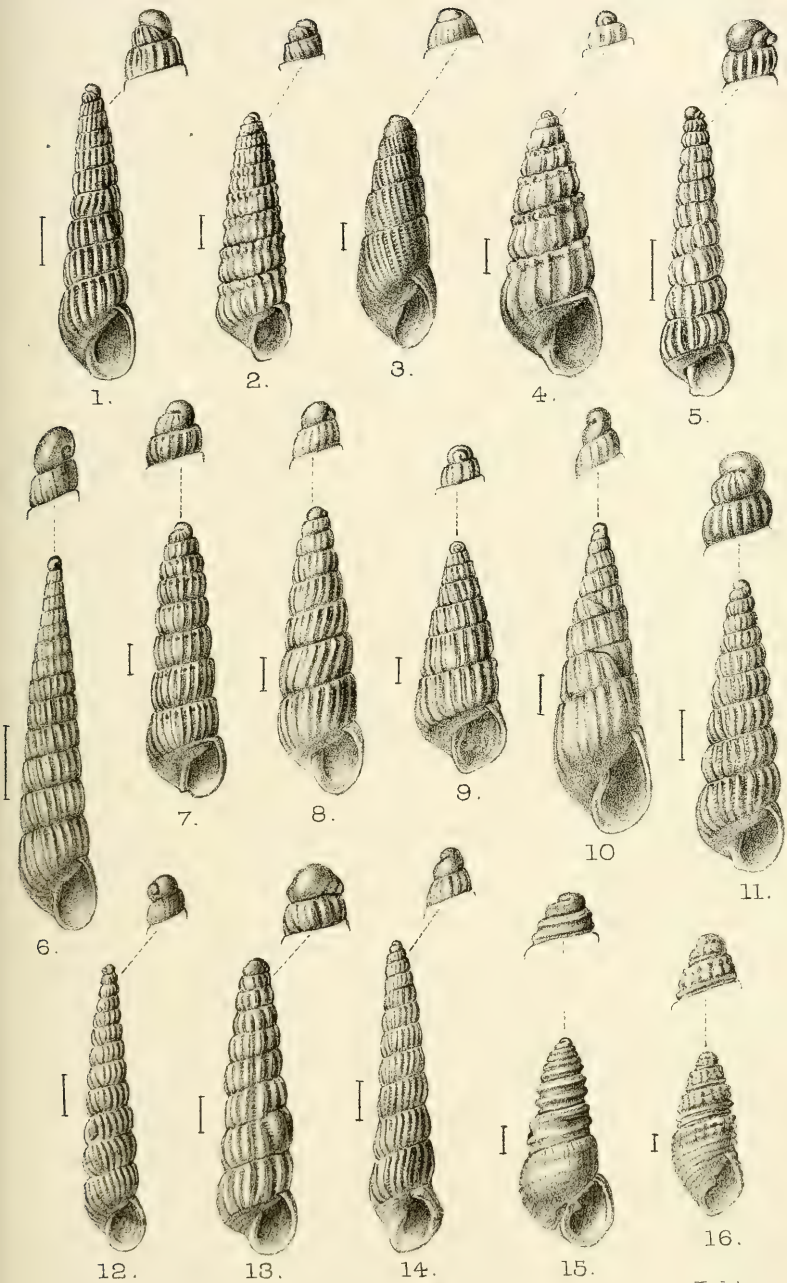
Hab.—M.C. Charbar, 7–40 fathoms.

I. Karachi, common; Bombay (Abercrombie).

I cannot follow Dall & Bartsch in making *Oscilla*,¹ A. Ad., subservient to *Cingulina*, A. Ad.² The columellar plication of the former is a conspicuous feature.

¹ Proc. Zool. Soc., 1867, p. 310.

² Ann. Mag. Nat. Hist., 1860, p. 414.



A. H. Searle, del et lith.

Huthamp

PYRAMIDELLIDÆ FROM THE PERSIAN GULF, ETC.

MIRALDA DIADEMA (A. Adams).

Parthenia diadema, A. Adams, Ann. Mag. Nat. Hist., vol. v, p. 479, 1860.

Odostomia (Miralda) diadema, A. Ad., op. cit., p. 321; Dall & Bartsch, Proc. U.S. Nat. Mus., vol. xxx, p. 356, pl. xvii, fig. 2.

Actæopyramis brevicula, Melvill & Standen, Ann. Mag. Nat. Hist., vol. xii, pl. xxii, fig. 14, 1903.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

I. Karachi, 7 fathoms.

From the dredging in the Gulf of Oman come the narrow forms named *brevicula*, which, I have no doubt, are identical with those called *diadema* from Karachi.

MIRALDA GEMMA (A. Adams).

Chrysallida gemma, A. Adams, Ann. Mag. Nat. Hist., vol. viii, p. 302, 1861.

Odostomia (Miralda) gemma (A. Ad.), Dall & Bartsch, Proc. U.S. Nat. Mus., vol. xxx, p. 356, pl. xxii, fig. 1.

Hab.—I. Karachi.

I identify this, with little doubt, from three Japanese specimens in my collection collected by Dr. Arthur Adams, and the admirable figure, reference to which is given above.

MIRALDA IDALIMA, Melvill. Pl. V, Fig. 16.

Miralda idalima, Melvill, Proc. Malac. Soc., vol. ii, p. 112, pl. viii, fig. 6.

Hab.—P.G. Bushire (?).

I. Bombay (Abercrombie).

The type is now refigured, as the first did not give details correctly. I cannot now find any Bushire specimens, and think most likely they belonged to *M. gemma*, A. Ad. If this be so, the type is unique, for the other example that was found in Bombay shell-sand at the same time, was soon mislaid, and never reappeared.

MIRALDA IMA (Melvill).

Odostomia (Miralda) ima, Melvill, Proc. Malac. Soc., vol. vii, p. 75, pl. vii, fig. 15.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, in shell-sand.

The type of this species, now in the British Museum, is well figured, and exhibits the penultimate whorl with two, the body-whorl with three spiral beaded rows, followed by a strong keel. With it occurred what at the time I considered the same species, with only two beaded rows on the last whorl, and these agree, as Mr. Hedley has pointed out,¹ with his *Pyrgulina umeralis* from Princess Charlotte Bay, North Queensland (J. Brazier).

¹ Proc. Linn. Soc. N.S.W., 1902, p. 11, pl. iii, fig. 32.

MIRALDA LÆTITIA (Melvill & Standen).

Actæopyramis lætitia, Melvill & Standen, Ann. Mag. Nat. Hist., vol. xii, p. 303, pl. xxii, fig. 4, 1903.

Odostomia (Miralda) lætitia (Melv. & Stand.), Proc. Zool. Soc., vol. ii, p. 396, 1901.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

A pretty nodulous species, like *Act. granulata*, Ad., in miniature.

MIRALDA OPEPHORA, Melvill. Pl. VI, Fig. 1.

Miralda opephora, Melvill, Mem. Manch. Soc., vol. xlii, No. 4, p. 21, pl. i, fig. 7.

Hab.—M.C. Charbar, 40 fathoms.

I. Karachi.

I refigure this species, which is conspicuous for its quadrate decussate interstices and delicate spiral basal striation.

MIRALDA UMERALIS (Hedley).

Pyrgulina umeralis, Hedley, Proc. Linn. Soc. N.S.W., 1902, p. 11, pl. iii, fig. 32.

Odostomia humeralis, Hedley, Proc. Linn. Soc. N.S.W., vol. xxxiv, p. 446, 1909.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 52' E.$, 156 fathoms, shell-sand.

See remarks under *M. ima*. This shell was described first as *umeralis*, perhaps by a *lapsus calami*, in which case the emended version might be allowed to stand. *Pyrgulina Zea*, Hedley,¹ judging by the figure, seems similar, but here in the penultimate whorl the lower keel is beaded. We do not yet know to what extent this species and its allies vary *inter se*.

PYRGULINA (EGILINA) CALLISTA, Melvill.

Pyrgulina callista, Melvill, Mem. Manch. Soc., 1893, pt. v, fig. 13.

Hab.—P.G. Kishm Island, 5 fathoms.

Mussandam, 47 fathoms.

M.C. Charbar. At low tide amongst mud and weed in loose rocks.

I. Karachi, rather common, dredged at 7 fathoms, alive, with many other small shells.

Bombay (Abercrombie).

This very select little species was originally described from specimens extracted from shell-sand gathered by Mr. Alexander Abercrombie in Bombay Harbour. The measurements are—

Long. 4, lat. 1.25 mm., sp. maj.

„ 3.10 „ 1 „ „ min.

It belongs to the group of which the type is *P. (Egilina) Mariella*,² A. Adams, from Japan, lately redescribed and refigured³ by

¹ Proc. Linn. Soc. N.S.W., 1902, pl. iii, fig. 34.

² Ann. Mag. Nat. Hist., vol. vi, p. 415, 1860.

³ Proc. U.S. Nat. Mus., vol. xxx, p. 354, pl. xxii, fig. 4.

Messrs. Dall & Bartsch, authors of the subgeneric title *Egilina*. I have specimens of *P. Mariella* in my own collection from Dr. A. Adams' Japanese gatherings; these show it to be of much the same build as *P. callista*, but smaller, sutural canaliculations not so sharply defined, lip not so squarrose, basal keels less pronounced. The specimens redescribed by Dall & Bartsch measure thus: long. 1·8, diam. 1 mm. Mine are a little larger, say 2×1 mm.

I believe that several species described of late years should be either merged with *Mariella* or *callista*, or placed in the same sub-genus. Imprimis, *Odontostomia (Pyrgulina) Mayi*, Tate,¹ from D'Entrecasteaux Channel, Tasmania, of which I possess a co-type, is exceedingly near; the only distinguishing mark I can find, judging from my specimens, is that the costæ are not so oblique as in *P. callista*.

Pyrgulina perspectiva, Hedley,² judging from figure and description, I consider identical with young examples of *P. callista*, obtained at Bombay. These are interstitially spirally striate. In all the more mature examples this striation seems quite obsolete. And likewise *Pyrgulina Bartschi*, Dautz. & Fisch.,³ a species intermediate in size, seems nearer to *P. callista* than to *P. Mariella*, both as regards character of ribs and subangulate mouth, and I consider it a synonym.

PYRGULINA (EGILINA) CÆLATA, A. Adams.

Pyrgulina cælata, A. Adams, Journ. Linn. Soc., vol. vii, p. 4; Ann. Mag. Nat. Hist., 1861, p. 303.

Turbonilla (Babelis) cælator, Dall & Bartsch, Proc. U.S. Nat. Mus., vol. xxx, p. 347, pl. xvii, fig. 9.

Hab.—I. Karachi.

A larger shell than *P. callista* in all its parts, in addition to which, owing to a median constriction of whorl, the ribs assume a slightly beaded appearance on either side of the sutures. Otherwise, the characters of sculpture are much the same. It is well figured by Dall & Bartsch (loc. cit., pl. xvii, fig. 9), but we cannot quite understand why it was placed in the genus *Turbonilla*, with a new sub-genus (*Babelis*) specially constructed for it; the columellar plait is strongly developed, and the sculpture and general build harmonize throughout with *Egilina*. The type is Japanese.

PYRGULINA (EGILINA) CHASTERIANA, n.sp. Pl. VI, Figs. 2, 2a.

P. testa parva, conico-fusiformi, tenui, olivaceo-alba, anfractibus 7, quorum apicales 2 vitrei—in nostro unico specimine fracti—cæteris ad suturas haud profunde canaliculatis, undique longitudinaliter costatis, costis anfractus apud supernos rectis, penultimo et ultimo obliquis et flexuosis, interstitiis lævibus, ultimo anfractu infra peripheriam ad basim acute sulcato, sulcis ad 6, et decussato, interstitiis quadratis, apertura magna, ovato-oblonga, labro tenui, columella leniter uniplicata. Long. 3·50, lat. 1·25 mm.

¹ Trans. Roy. Soc. S. Australia, 1898, p. 84, pl. ii, fig. 6.

² Proc. Linn. Soc. N.S.W., pt. i, p. 10, pl. iii, fig. 33, 1902.

³ Journ. de Conch., vol. liv, p. 191, pl. vii, fig. 1.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

The nearest approximation to this species is to be found in *P. glycisma*; the mouth, however, is proportionately smaller in that species, the sutures are not so impressed, the sculpture at the base quite different, and the columellar plait is only lightly expressed in *P. Chasteriana*.

I name this beautifully decorated little shell in memory of one for whom the Pyramidellidæ possessed a great and lasting fascination, as exemplified by the close and especial study he had given for years to the British and Mediterranean forms of *Eulimella*, *Turbonilla*, and *Odostomia*.

Dr. George William Chaster, of Southport, passed away after an illness of only three days, on May 5 last, at the early age of 47, widely mourned and deeply regretted by all who knew him. It is a great satisfaction to think that his valuable collections of natural history, ethnology, etc., are to remain intact, having been purchased *en bloc* by Dr. W. Evans Hoyle, Director of the Welsh National Museum, Cardiff, for the benefit of that institution.

PYRGULINA (EGILINA) GLYCISMA, Melvill.

Pyrgulina glycisma, Melvill, Ann. Mag. Nat. Hist., vol. iv, p. 95, pl. i, fig. 16, 1899.

Hab.—P.G. Bushire.

I. Karachi.

Since the description of this interesting species larger examples have come to hand, measuring long. 4, lat. 1.35 mm. Besides this there is nothing to add to what has already been said. No immediately seems to exist, if we except *P. Claudoni*, Dautz. & Fisch.,¹ which so exactly, except in size (long. 2, diam. 1 mm.), corresponds, that we suspect it to be a non-adult state of it.

Sect. *Eupyrgulina*.

PYRGULINA CASTA (A. Adams).

Monoptygma casta, A. Adams, Proc. Zool. Soc., 1851, p. 223.

Hab.—I. Bombay (Abercrombie); Karachi.

The specimens are mostly worn, and not very conclusive.

PYRGULINA COMACUM,² n.sp. Pl. VI, Fig. 3.

P. testa parva, rimatula, oblonga, turrato-gradatula, alba, nitida, papyracea, delicata, anfractibus 7, quorum duo læves, parum nitentes, globulosi, cæteris gradatis, undique longitudinaliter flexuoso-costulatis, superne, juxta suturas, gemmulatis, sub lente interstitialiter infra tristriatis, ultimo ad peripheriam, aliter lævissimo, apertura ovata, peristomate fere continuo, columella paullum reflexa, uniplicata. Long. 3.25, lat. 1.15 mm.

¹ Journ. de Conch., vol. liv, p. 189, pl. vi, fig. 14.

² κώμακον, a delicacy.

Hab.—P.G. Gulf of Oman, lat. $25^{\circ} 39' N.$, long. $57^{\circ} 19' E.$, 110 fathoms.

A shining, flexuose-ribbed species, of some refinement and beauty. With aid of a 1 inch objective spiral interstitial lines, three in number, may be discovered at the base of the antepenultimate and penultimate whorls, and in the centre of the body-whorl, otherwise the shell is quite smooth, as are the ribs. These are spirally gemmulate just below the sutures.

PYRGULINA CRYSTALLOPECTA,¹ n.sp. Pl. VI, Fig. 4.

T. testa perminuta, anguste attenuata, fere recta, crystallina, delicatissima, anfractibus 8, quorum duo apicales rotundo-bulbosi, læves, cæteris nitidis, vitreis, impressis, ventricosulis, undique arcte longitudinaliter recte costulatis, costis juxta suturas spiraliter gemmulatis, utrinque incrassatis, subcanaliculatis, interstitiis minute striatis, apertura fere rotunda, labro ad basim elongato, columella obliqua, plica obscurissima vel absente. Long. 2, lat. .75 mm.

Hab.—M.C. Charbar, 40 fathoms.

A small, vitreous, straight, very narrow *Pyrgulina*, with the whorls thickened on each side of the subcanaliculate sutures, the regular and close ribs are gemmulate above, just below the sutures, and the interstices between the ribs finely spirally striolate. The columella plait is obscure, though just below the orifice. In form a *Turbonilla*, but agreeing in many points with the genus to which we tentatively assign it.

PYRGULINA DECORATA (Philippi).

Odontostomia decorata, Phil., Zeitsch. für Malak., 1849, p. 29.

Hab.—I. Karachi; Bombay (Abercrombie).

I incline to the few specimens, all in worn and poor condition from the above localities, being rather this species than *P. interstriata*, Sowerby, which has its headquarters in New Caledonia.

PYRGULINA DAUTZENBERGI, n.sp. Pl. VI, Fig. 5.

P. testa perminuta, ovato-conica, nitida, alba, anfractibus ad 5, quorum apicales magni, bulbosi, heterostrophii, cæteris gradatulis, lævissimis, undique longitudinaliter rotundicostatis, costis nitidis, interstitiis lævibus, ultimo anfractu magis numerosis, circa 26, haud apud basim evanidis, apud peripheriam linea funiculari spiraliter prædito, apertura ovata, peristomate fere continuo, crassiusculo, columella obliqua, fortiter uniplicata. Long. 2.5, lat. 1 mm.

Hab.—Bombay (F. W. Townsend).

A remarkably select *Pyrgulina*, though so very minute. The peristome being thickened and well formed, causes us to think it has attained its full growth. The ribs of the upper whorls are thicker, proportionately, and likewise not so numerous as those on the body-whorl, this being decorated with one spiral funicular line about the

¹ κρυσταλλόπηκτος, crystalline.

periphery, the ribs are likewise gemmulate just below the sutures. I dedicate this unique shell to M. Philippe Dautzenberg, of Paris, whose labours in the cause of malacological science, including the smaller, but no less beautiful forms of mollusca, are so fully recognized and appreciated by all students.

Pyrgulina eccrita,¹ n.sp. Pl. VI, Fig. 6.

P. testa parva, rimata, cylindro-fusiformi, alba, nitida, anfractibus $7\frac{1}{2}$, quorum $2\frac{1}{2}$ vitrei, læves, heterostrophii, apice ipso immerso-planato, cæteris quatuor ad suturas inciso-impressis, minime ventricosus, arcte longitudinaliter costulatis, costis, simul ac interstitiis, lævissimis, ultimo anfractu paullum elongato, apertura parva, subrotunda, labro effuso, columella uniplicata. Long. 5.75, lat. 2 mm.

Hab.—M.C. Lat. $25^{\circ} 10'$ N., long. $60^{\circ} 34'$ E., off Charbar at 40 fathoms.

Much like *P. interstriata*, Sowerby, *decorata*, Philippi, or *Edgarii*, Melvill, but the interstices between the longitudinal ribs are, with the rest of the shell, quite smooth and shining. A few examples only.

Pyrgulina edana,² n.sp. Pl. VI, Fig. 7.

P. testa minuta, ovata, nitida, albo-crystallina, lævicostata, delicata, anfractibus ad 5, quorum duo nucleares depresso-planati, heterostrophii, vitrei, cæteris apud suturas multum impressis, quasi-canaliculatis, penultimo et antepenultimo biangulatis, ad angulum spiraliter funiculo-liratis, nitide gemmulatis, ultimo ad peripheriam simili modo spiraliter gemmulato, etiam supra, infra suturas, numero costarum longitudinalium ad 22, apertura subrotunda, parva, peristomate fere continuo, crassiusculo, columella obliqua, uniplicata. Long. 1.75, lat. 1 mm.

Hab.—Bombay (F. W. Townsend).

A most refined, canaliculate species, smooth, both as regards the costæ and interstitially, the whorls five in number, two being apical, heterostrophe, the rest ventricose, suturally constricted, many ribbed, adorned with two lirate rows of spiral gemmules, one above, the other in the centre of the whorl. The mouth is roundish, peristome well formed and almost continuous, columella once plaited.

Pyrgulina edgarii, Melvill.

Pyrgulina Edgarii, Melvill, Proc. Malac. Soc., vol. ii, p. 114, pl. viii, fig. 21.

Hab.—I. Karachi, very common, amongst mud, weed, and loose stones at low tide; Bombay (Abercrombie).

A small species, with rather coarse smooth ribs, and interstitial striation, shell bluntly cylindrical, varying a little in length and compactness.

¹ ἑκκριτος, select, set apart.

² ἑδανός, sweet.

PYRGULINA EPENTROMA (Melvill).

Rissoa epentroma, Melvill, Proc. Malac. Soc., vol. ii, p. 110, pl. viii, fig. 23.

Mumiola epentroma, Melv., Proc. Zool. Soc., vol. ii, p. 392, 1901.

Hab.—I. Karachi, mud-covered rocks at low tide; Bombay (Abercrombie).

I am still diffident about the proper location of this species. It is pure white, compact, of some substance, rissoiform, with thickened rounded peristome, incrassate longitudinal ribs, interstitially striate, six-whorled, somewhat turreted, columella simple.

PYRGULINA EPENTROMIDEA, Melvill.

Pyrgulina epentromidea, Melvill, Ann. Mag. Nat. Hist., vol. iv, p. 94, pl. i, fig. 15, 1899.

Hab.—P.G. Gulf of Oman, 25 fathoms in mud, lat. $26^{\circ} 23' N.$, long. $54^{\circ} 53' E.$ Also very abundant at 156 fathoms.

A beautiful shining white little shell, with strong columellar plait, many ribbed, every part being smooth.

PYRGULINA HERVIERIOIDES (Melvill).

Odostomia (Pyrgulina) hervierioides, Melvill, Proc. Malac. Soc., vol. vii, p. 74, pl. vii, fig. 12.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

The ribs and interstices are quite smooth in this species, which in contour resembles *P. thelxinoia* often occurring with it.

PYRGULINA MILICHA,¹ n.sp. Pl. VI, Fig. 8.

P. testa perparva, cylindrica, solidiuscula, perlævi, nitida, anfractibus $5\frac{1}{2}$, quorum duo apicales, læves, bulbosi, heterostrophii, cæteris apud suturas impressis, gradatulis, arcte et recte longitudinaliter costulatis, costis, simul ac interstitiis, lævibus, apertura anguste ovata, labro paullum effuso, columella uniplicata. Long. 2, lat. 1 mm.

Hab.—I. Karachi.

M.C. Charbar, 40 fathoms.

A very minute, compact, solidly built shell, very smooth, closely longitudinally straightly ribbed, ribs incrassate, interstices showing no striation. The nuclear whorls are large proportionately, heterostrophe, globular, white, the remaining whorls shouldered, and some specimens show signs of spiral gemmulation below the sutures. I have seen several examples, and consider that it occupies a somewhat isolated position in the genus.

PYRGULINA PIRINTHELLA,¹ n.sp. Pl. VI, Fig. 9.

P. testa perminuta, delicata, attenuata, cylindrica, angustissime rimata, alba, parum nitente, anfractibus 5–6, quorum duo heterostrophii, bulbosi, ad apicem ipsum deplanata, cæteris gradatulis, apud suturas

¹ μείλιχος, gentle.

² πείρις, a basket of wicker-work.

impressis, undique longitudinaliter obliquicostatis, interstitiis spiraliter arcte striatulis, ultimo anfractu ad basim, infra peripheriam evanidis, apertura ovata, peristomate fere continuo, incrassatulo, columella excavata, obscure plicata. Long. 2, lat. .50 mm.

Hab.—Off Karachi Harbour.

A very elegant but extremely small turreted species, near *P. tenerrima* and *thelxinoa*, Melv., or *Melvilli*, Dautz. & Fisch.¹ The smooth longitudinal ribs are proportionately thick, and the spiral interstitial striation well marked.

PYRGULINA POLEMICA, n.sp. Pl. VI, Fig. 10.

P. testa minutissima, tenui, alba, nitida, delicata, anfractibus $4\frac{1}{2}$, quorum apicales magni, bulbosi, lævissimi, cæteris tribus magnopere gradatulis, undique longitudinaliter costatis, costis anfractus ultimi circiter 16, interstitiis, simul ac costis, lævibus, anfractu ultimo ad medium spiraliter unilirato, costis apud suturas angulati, gemmulatis, crassiusculis, prominulis, apertura ovata, peristomate incrassato, extus supra unidenticulato, columella uniplicata. Long. 1.75, lat. .075 mm.

Hab.—Off Bombay (F. W. Townsend).

One of the minutest of shells, but very decided in design and character of contour. The sharp median line at the periphery of the body-whorl is noteworthy, the longitudinal ribs, fairly numerous, are beaded at the upper angle, and form an encircling coronal round the whorls. The nuclear whorls are large, proportionately speaking, bulbous, and smooth. Only two examples have been yet found.

PYRGULINA PYRGOMELLA, Melvill.

Pyrgulina pyrgomella, Melvill, Proc. Malac. Soc., vol. ii, p. 112, pl. viii, fig. 24.

Odostomia (Pyrgulina) pyrgomella, Melvill & Standen, Proc. Zool. Soc., vol. ii, p. 396, 1901.

Hab.—I. Karachi, on rocks at low tide, very rare; Bombay (Abercrombie).

Specimens from the latter locality, now in the Manchester Museum, vary in size and length. Its conspicuous columellar plait distinguishes it from *Turbonilla templar*is, Melvill. Both these species are elegant scalariform shells.

PYRGULINA REDEMPTA, n.sp. Pl. VI, Fig. 11.

P. testa attenuata, turrito-gradata, alba, nitida, anfractibus ad 8, quorum apicales duo vitrei, bulbosi, heterostrophii, cæteris apud medium constrictis, longitudinaliter costulatis, costulis arctis, superficialibus, indistinctis, supra, apud suturas, spiraliter gemmulatis, ultimo anfractu fere recto, costulis infra peripheriam evanidis, versus basim lævi, nitido, apertura ovata, peristomate tenui, columella fortiter uniplicata. Long. 4, lat. 1 mm.

¹ Journ. de Conch., vol. liv, p. 185, pl. vi, fig. 10.

Hab.—P.G. Bushire; Mussandam.
I. Bombay.

Allied to, if indeed it be not an extreme variety of, *P. pyrgomella*, but the much larger number of lightly impressed longitudinal ribs, spirally gemmulate below the sutures, the smaller size, and straighter body-whorl serve to distinguish it. Singly, it has occurred in shell-sand at Bombay, whence comes the type figured, and at two places in the Persian Gulf.

PYRGULINA TENERRIMA (Melvill).

Odostomia (Pyrgulina) tenerrima, Melvill, Proc. Malac. Soc., vol. vii, p. 74, pl. vii, fig. 13.

Hab.—P.G. Gulf of Oman, lat. 24° 58' N., long. 56° 54' E., 156 fathoms, shell-sand.

Paucicostate, with gradate whorls, the broad intercostal spaces finely striate. It occurred very rarely, but could easily be overlooked, as it is one of the minutest species known. An error occurs in the original description, the interstices being given as smooth.

PYRGULINA THELXINOA (Melvill).

Odostomia (Pyrgulina) thelxinoa, Proc. Malac. Soc., vol. vii, p. 75, pl. vii, fig. 14.

Hab.—P.G. Gulf of Oman, with *P. tenerrima*, at 156 fathoms.

This minute shell is near *P. Sykesii*, Dautz. & Fischer, but with more frequent ribs, and the intercostal spaces not, therefore, so broad. The form is precisely similar, and measurements likewise.

PYRGULINA ZIDORA, n.sp. Pl. VI, Fig. 12.

P. testa conico-fusiformi, rimata, solidula, sordide alba, anfractibus ad 7, quorum apicales heterostrophii, parvi, cæteris 5 longitudinaliter arcte recticostatis, ad suturas multum impressis, interstitiis lævibus, ultimo usque ad basim ipsam æque et regulariter costulato, apertura ovata, labro paullum effuso, margine columellari incrassato, fortissime uniplicato. Long. 4.50, lat. 2 mm.

Hab.—P.G. Mussandam, 50 fathoms, April, 1910.

An interesting species, with some leaning towards the typical section of the order, and we only describe it tentatively as a *Pyrgulina*, since at present it appears to come nearest to our *P. epentromidea*, the chief points of difference being in the much closer and more incrassate character of the ribs, and especially their continuance over the whole of the body-whorl, not being evanescent below the periphery, as in the case with the lighter and more superficial costæ of the older species. The columellar plait is in both species very strongly pronounced.

ODOSTOMIA ANABATHMIS,¹ n.sp. Pl. VI, Fig. 13.

O. testa perparva, albo-lactea, ovato oblonga, lævigata, nitida, anfractibus 6, quorum duo apicales heterostrophii, cæteris gradatis,

¹ ἀνάβαθμῖς, a stair, from the gradate whorls.

ad suturas multum impressis, ultimo anfractu paullum prolongato, apertura ovata, labro effuso, columella obliqua, uniplicata. Long. 2.50, lat. 1 mm.

Hab.—Gulf of Oman, long. 25° 39' N., long. 57° 19' E., 110 fathoms.

A very small shining white smooth *Odostomia*, with affinity towards the more pronounced *O. carinata*, H. Ad., also occurring in the same region. The body-whorl is, however, free from peripheral carination. Mouth somewhat narrowly oval, columella obliquely plaited. *O. antelia* is a somewhat broader shell.

ODOSTOMIA ANTELIA, Melvill.

Odostomia antelia, Melvill, Proc. Malac. Soc., vol. ii, p. 113, pl. viii, fig. 22.

Hab.—P.G. Gulf of Oman, lat. 24° 49' N., long. 55° 56' E., 225 fathoms, mud; also at 156 fathoms, in the locality so frequently given, among shell-sand.

I. Karachi, very rarely; Bombay (Abercrombie), whence the type was procured.

A small shining white, plain species, very smooth, some differences of form existing, and perhaps two species may be confused together. More material is wanted, however, before this can be truly discerned.

ODOSTOMIA CARINATA, H. Adams.

Odostomia carinata, H. Adams, Proc. Zool. Soc., 1873, p. 206, pl. xxiii, fig. 4.

Hab.—P.G. Bushire. Gulf of Oman, lat. 24° 15' N., long. 37° 57' E., 37 fathoms.

I. Karachi, off mud at anchorage.

A well-marked species, at first thought by malacologists to be a possible monstrosity, but we have seen many examples, all of the same form.

O. contracta,¹ Dautz. & Fischer, from Annam, is very similar, but the carinæ hardly so pronounced.

ODOSTOMIA CHARICLEA, n.sp. Pl. VI, Fig. 14.

O. testa parva, ovata, perlævigata, parum nitida, albo-lactea, anfractibus $4\frac{1}{2}$, *quorum* $1\frac{1}{2}$ *apicales heterostrophii, globulosi, cæteris ad suturas gradatis, ventricosulis, ultimo rapide accrescente, magno, apertura ovata, peristomate incrassato, fere continuo, columella fortiter obliquiplicata.* Long. 3, lat. 1 mm.

Hab.—Bombay (Abercrombie).

An ovate, perfectly smooth shell, free from any sculpture whatsoever, the whorls gradate at the sutures, body-whorl proportionately very large, mouth oval, lip nearly continuous, columella once obliquely plaited.

¹ Journ. de Conch., vol. liv, p. 184, pl. vi, fig. 9.

ODOSTOMIA DORICA, Melvill.

Odostomia dorica, Melvill, Journ. Malac., vol. xi, p. 82, pl. viii, fig. 9.

Hab.—P.G. Maskat, 15 fathoms; Gulf of Oman, lat. $24^{\circ} 58' N.$, long. $56^{\circ} 51' E.$, 156 fathoms.

Known by the upper whorls exhibiting longitudinal riblets or nodules, the apex and two lowest whorls remaining quite smooth. It is one of the rarest of the local *Odostomie*.

ODOSTOMIA EUTROPIA, var. CRASSISPIRA. Pl. VI, Fig. 15.

Odostomia eutropia, Melvill, Ann. Mag. Nat. Hist., vol. iv, p. 94, pl. ii, fig. 14, 1899.

Hab.—P.G. Bushire, Mussandam, 47 fathoms; Gulf of Oman, lat. $26^{\circ} 23' N.$, long. $54^{\circ} 53' E.$, 250 fathoms; lat. $24^{\circ} 58' N.$, long. $56^{\circ} 54' E.$, 156 fathoms, shell-sand.

M.C. Off Charbar, 40 fathoms.

I. Karachi, on mud, 25 fathoms; Bombay (Abercrombie), rarely.

This shining, solid, white little species is the most abundant of all the small *Odostomie* in this region, and, as might be expected therefore, it varies considerably. It may be known by its canaliculate sutures and angled periphery. Some examples are oval in form, with less marked carination; others have the whorls, at all events in the upper part, gradate and turreted.

Mr. Charles Hedley, having seen some Gulf of Oman specimens, considers¹ it synonymous with *O. compta*, Brazier, which he mentions as common and variable, and first described from the Chevert Collection. He likewise writes that it is abundant at the Hope Islands, Queensland, and has been traced south to the Palace Islands and Port Curtis, and westerly to Van Diemen's Inlet in the Gulf of Carpentaria. I believe this species, in one or other of its varieties, will be found in intermediate localities, and having become possessed of many Pyramidellidæ collected by Dr. Arthur Adams in Japan, I find a few specimens which are probably *O. subangulata*, A. Adams, and these may be the same as both *eutropia* and *compta*.

Pending, therefore, a more complete investigation as to the variations and ramifications of this species and its nearest allies, I do not alter the name at the present juncture, especially as I have never seen Mr. Brazier's species. I figure a large turreted variety, much thickened at the sutures, which may be designated as var. *crassispira*, measuring long. 7, lat. 2.25 mm.

ODOSTOMIA LITIOPINA, Melvill & Standen.

Odostomia litiopina, Melvill & Standen, Proc. Zool. Soc., vol. ii, p. 395, pl. xxiii, fig. 1, 1901.

Hab.—P.G. Gulf of Oman, lat. $25^{\circ} 24' N.$, long. $57^{\circ} 27' E.$, 241 fathoms; also lat. $25^{\circ} 31' N.$, long. $57^{\circ} 14' E.$, 198 fathoms, mud.

No more of this somewhat obscure olivaceous species have been found.

¹ Proc. Linn. Soc. N.S.W., vol. xxxiv, p. 445.

ODOSTOMIA MAJOR, Melvill & Standen.

Odostomia major, Melvill & Standen, Proc. Zool. Soc., vol. ii, p. 395, pl. xxiii, fig. 2, 1901.

Hab.—Maskat (Muscat), 10 fathoms (F. W. T.).

I. Karachi, 3 fathoms.

Undoubtedly allied to *O. eutropia*, but not carinate at the periphery, nor are the sutures so channelled. It is a large species, measuring long. 6, lat. 2 mm.

ODOSTOMIA SYRNOLOIDES, Melvill.

Odostomia synnoloides, Melvill, Proc. Malac. Soc., vol. ii, p. 113, pl. viii, fig. 13.

Hab.—P.G. Gulf of Oman, lat. $24^{\circ} 49' N.$, long. $56^{\circ} 56' E.$, 225 fathoms; lat. $24^{\circ} 58' N.$, long. $57^{\circ} 59' E.$, 137 fathoms; lat. $26^{\circ} 35' N.$, long. $54^{\circ} 31' E.$; and lat. $24^{\circ} 5' N.$, long. $57^{\circ} 35' E.$; 205 fathoms, mud.

Smaller than *O. major*, with very slight impression suturally, and differently formed mouth.

ODOSTOMIA ZALEUCA,¹ n.sp. Pl. VI, Fig. 16.

O. testa minuta, angusta, oblonga, solidiuscula, albo-lactea, nitida, lævigata, anfractibus 6, quorum apicales duo bulbosi, heterostrophii, cæteris paullum ventricosi, ad suturas impressis, striis internis spiraliter præditis, ultimo paullum prolongato, apertura ovata, labro effuso, columella fortiter uniplicata. Long. 2.10, lat. 1 mm.

Hab.—M.C. Off Charbar, 40 fathoms.

A very small, milky-white, smooth species, the internal spiral striae showing distinctly through its pellucid substance, differing from its near congeners in the seas—*O. antelia* especially—in greater narrowness and straightness of contour, smaller mouth, and differently situated plica.

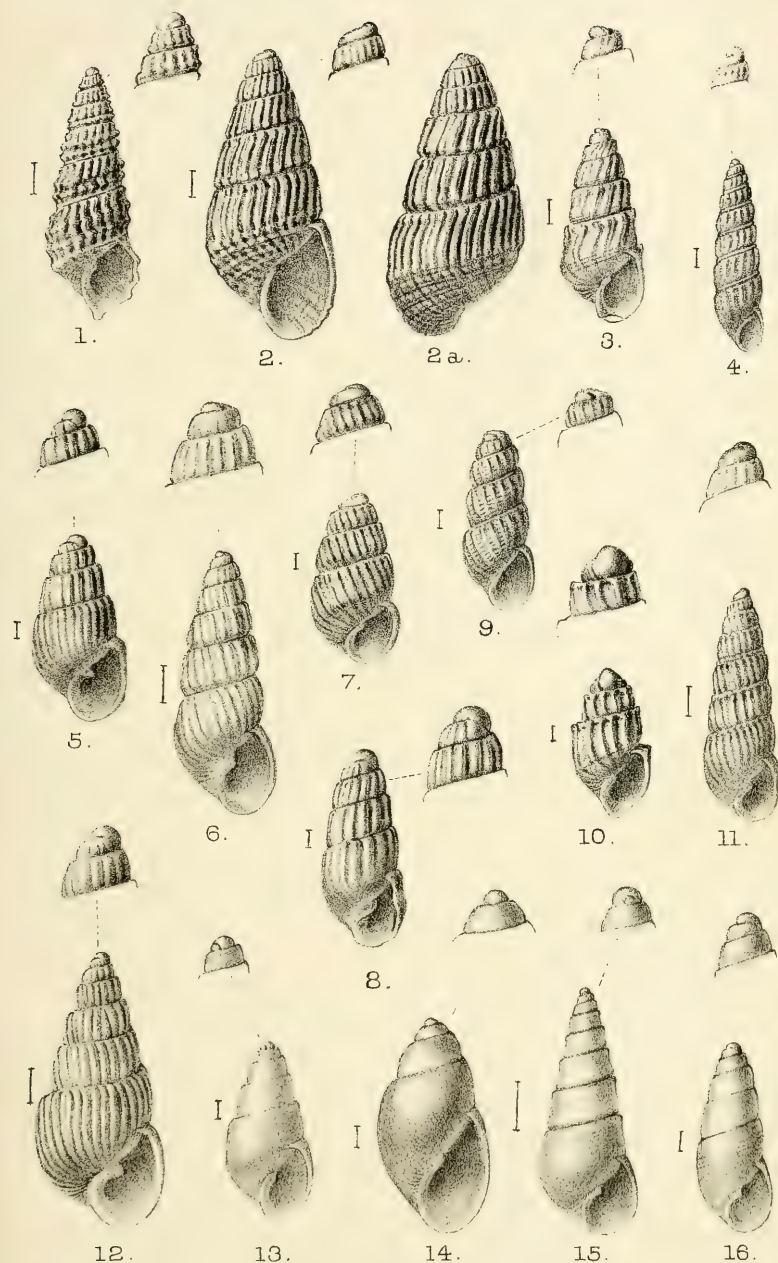
EXPLANATION OF PLATES IV-VI.

PLATE IV.

FIG.

1. *Synnola clearete*, n.sp.
2. *S. Karachiensis*, Melv.
3. *Styloptygma beatrix*, n.sp.
4. *S. cometes*, n.sp.
5. *Agatha vestalis*, n.sp.
6. *Elusa brunneomaculata*, Melv.
7. *E. enclata*, n.sp.
8. *Eulimella maia*, n.sp.
9. *E. Kaisensis*, Melv.
10. *Turbonilla basilica*, Melv.
11. *T. eucteana*, n.sp.
12. *T. eumenes*, n.sp.
13. *T. fraterna*, n.sp.
14. *T. galactodes*, n.sp.
15. *T. icela*, n.sp.

¹ ζάλευκος, very white.



A.H. Searle, del et lith.

Huth, imp.

PYRAMIDELLIDÆ FROM THE PERSIAN GULF, ETC.

PLATE V.

FIG.

1. *Turbonilla julia*, n.sp.
2. *T. Michaelis*, n.sp.
3. *T. neogila*, n.sp.
4. *T. oligopleura*, n.sp.
5. *T. pachypleura*, n.sp.
6. *T. Phyllidis*, n.sp.
7. *T. punctillum*, n.sp.
8. *T. quæstiosa*, n.sp.
9. *T. Sykesii*, n.sp.
10. *T. templaris*, Melv.
11. *T. Townsendi*, n.sp.
12. *T. uncinata*, n.sp.
13. *T. zetemia*, n.sp.
14. *T. colpodes*, n.sp.
15. *Oscilla evanida*, n.sp.
16. *Miralda idalina*, Melv.

PLATE VI.

1. *Miralda opephora*, Melv.
- 2, 2a. *Pyrgulina (Egilina) Chasteriana*, n.sp.
3. *P. comacum*, n.sp.
4. *P. crystallopecta*, n.sp.
5. *P. Dautzenbergi*, n.sp.
6. *P. eeerita*, n.sp.
7. *P. edana*, n.sp.
8. *P. milicha*, n.sp.
9. *P. pirinthella*, n.sp.
10. *P. polemica*, n.sp.
11. *P. redempta*, n.sp.
12. *P. zidora*, n.sp.
13. *Odostomia anabathmis*, n.sp.
14. *O. chariclea*, n.sp.
15. *O. eutropia*, Melv., var. *crassispira*, nov.
16. *O. zaleuca*, n.sp.

ON THE ANATOMY OF *RHYSOTA FOULLIOYI*.

By R. H. BURNE, M.A.

Read 10th June, 1910.

PLATES VII AND VIII.

THE specimen described below came from New Guinea and was kindly given to me for dissection by the Secretary of the Society, Mr. G. K. Gude, to whom I wish to tender my best thanks for the opportunity of examining it. It was in excellent condition.

External Appearance.

The snail was slightly contracted, the tentacles and fore-part of the foot being withdrawn.

The general ground colour of the body and foot is buff yellow, fairly pure upon the parts of the foot normally protected by the overhanging shell, but upon the head and tail dusky, and clouded with black, as if the snail had been dipped in ink and the superfluous ink washed off.

The sole of the foot is pure buff yellow, and is not divided into median and lateral areas.

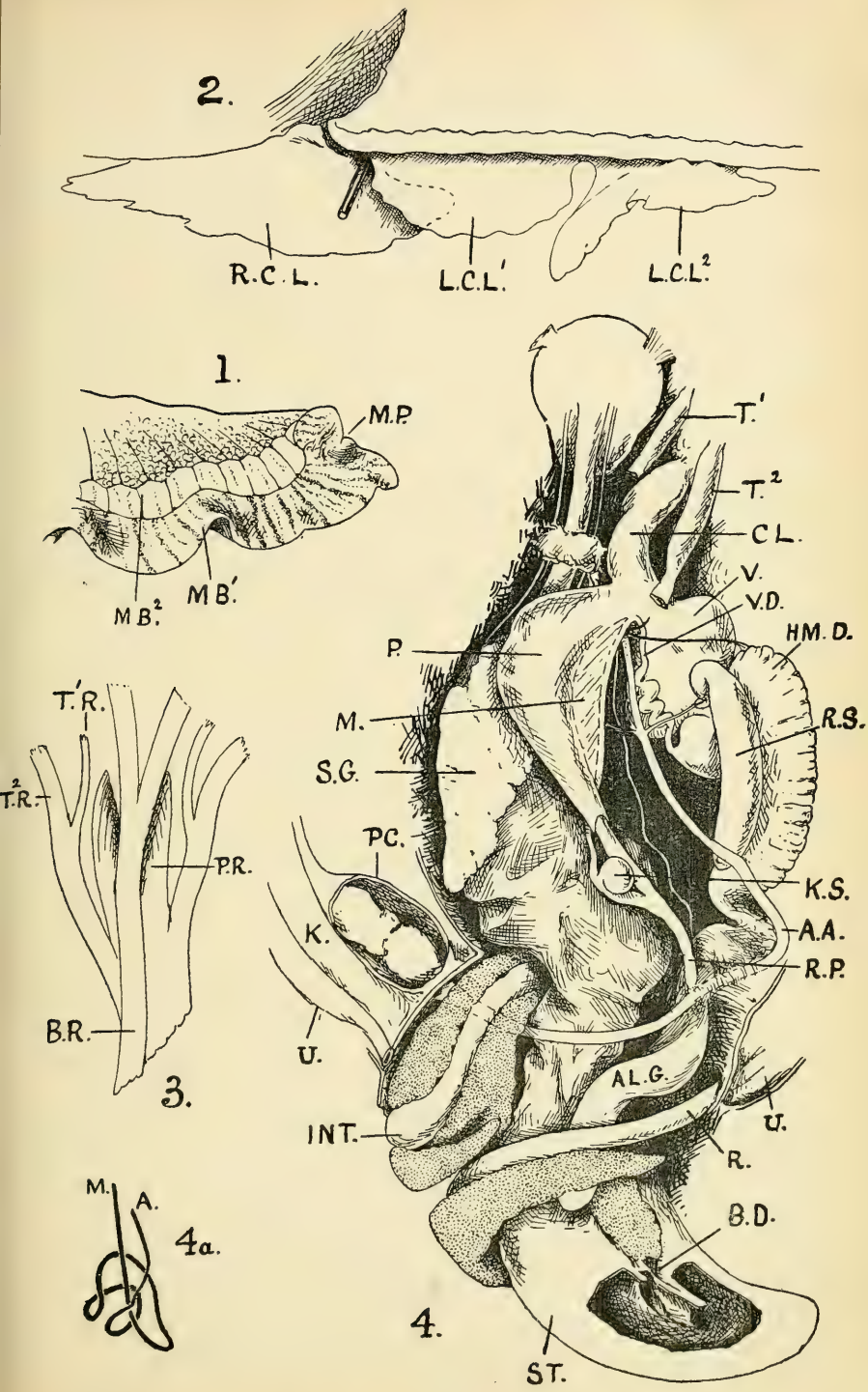
The upper surface of the foot behind the shell is bluntly keeled. The posterior end is truncated and deeply cleft by a cruciform, or probably in the expanded state pear-shaped, mucous pore. The upper lip of the pore is slightly prominent, but does not form a definite 'horn' (fig. 1).

The edge of the foot is bordered by a double selva or marginal band (fig. 1). The lower band is twice the breadth of the upper, and meets its fellow posteriorly above the mucous pore. It is banded with vertical black stripes, which with fair regularity are alternately broad and narrow. The upper band originates in front, below the posterior extremity of the lateral lip, and is at first a definite though small fold overhanging the lower band. However, throughout practically the whole length of the foot, the two bands are separated only by a narrow groove. In a similar way the upper band is bounded above by a narrow groove, and is further divided by vertical grooves into a series of quadrangular areas, whose boundaries in the main correspond with the broader black lines of the lower border. Above, a series of grooves pass upwards from the margin of the upper band, and are lost towards the mid-dorsal line of the foot.

The mouth (fig. 7) is encircled by a beaded lip. Between the chin and the foot are a pair of thin lateral lips (fig. 7, L²) that project forward in the horizontal plane and extend from beneath the lesser tentacle to the anterior mid-line.

The mantle border (fig. 2) is provided with strongly developed cervical lobes. Shell lobes are absent.

The right cervical lobe towards the left forms the floor of the respiratory orifice and is here produced as a free process for some



ANATOMY OF RHYSOTA FOULLIOYI.

distance beneath the right half of the left lobe. The left lobe is completely divided into two parts, the left of which is considerably produced at its right end.

The Mantle-cavity.

The kidney, pericardium, ureter, and rectum occupy the usual positions. The kidney (fig. 6) is long and narrow, more than twice as long as the pericardium. Its cardiac end is to some extent broadened out upon the pericardium. The plan of venation of the lung-sac is shown in fig. 6.

The ureter opens by a minute pore just above the anus, and a groove leads the excretion to the right to a cleft in the lower margin of the concave surface of the visceral hump, thus away from the respiratory orifice.

The Internal Organs.

Upon cutting open the body from above, the organs when slightly pushed to the right and left have the appearance shown in fig. 4.

The Alimentary Canal. Figs. 4, 4a.

The jaw was unfortunately not seen.

The buccal mass is small, oval in shape from above, concave in profile below, and without a prominent radula-sac.

The oesophagus is narrow, though definitely sacculated below. It enlarges with some suddenness to form a voluminous crop, which passes without much diminution in calibre into the stomach. The stomach, shortly after receiving the bile-duct, is reflected on itself at the extreme end of the visceral hump to form the first part of the intestine, which passes forward beneath the hinder extremity of the crop, makes two loops among the liver lobes, and reaches the anus along the right side of the mantle-cavity in the usual way.

The salivary glands are united to form a thin sheet upon the dorsal surface of the crop. Their ducts enter the buccal cavity in the usual position on either side of the origin of the oesophagus.

The radula (fig. 8) consists of some 189 teeth in the transverse row (94:1:94). Both median and lateral teeth are monocuspid, those towards the margins forming simple needle-like hooks. The rows are nearly straight from side to side, with the least possible angle at the centre.

The Generative Organs. Figs. 4, 5, 5a.

The genital pore lies close below the optic tentacle. It leads into a long cylindrical and highly muscular vestibule (CL.) common to the openings of the penis and vagina. In the natural position the male organs lie to the left, the female and hermaphrodite organs to the right. The female consist of a vagina, receptaculum seminis, and oviduct; the male of a penis, epiphallus, kalk-sac, and vas deferens.

The vagina opens into the apex of the vestibule. It is a globular chamber communicating at its apex with a long thin-walled and bluntly pointed receptaculum seminis, and through an aperture in

its ventral wall with the oviduct. In the natural position the receptaculum is spirally twisted at its origin, and lies closely applied to the concave surface of the hermaphrodite duct.

The penis opens into the vestibule opposite the mouth of the vagina. It is of large size, swollen in the middle, and enveloped to within a short distance of its retractor muscle by a loose sheath of muscle. At the point of attachment of its retractor muscle it is sharply bent upon itself, but cannot be said to form a cæcum. The segment between this bend and the vas deferens (epiphallus) is short, and at its distal end has a large globular and intensely white kalk-sac. The vas deferens passes forward beneath the penis, and thence in a mesentery of its own to the apex of the cloaca. At this point it is reflected around the anterior aorta and pleural nerves upon the surface of the vagina, and combines with the oviduct to form the hermaphrodite duct in the usual way.

The penis, when exposed by dividing the loose muscular sheath mentioned above, is seen to owe a large part of its swollen appearance to a double lobulated glandular development of its convex surface. The inner surface of the penis is grooved dorsally to form a seminal channel, with strongly dentate borders. The terminal dentations or papillæ are particularly pronounced, and no doubt form a papillate extremity to the organ when everted.

The retractor penis is attached to the right side of the body, close to the anterior aorta, and directly above the base of the albumen gland.

The ovotestis was destroyed.

The Retractor Muscles. Fig. 3.

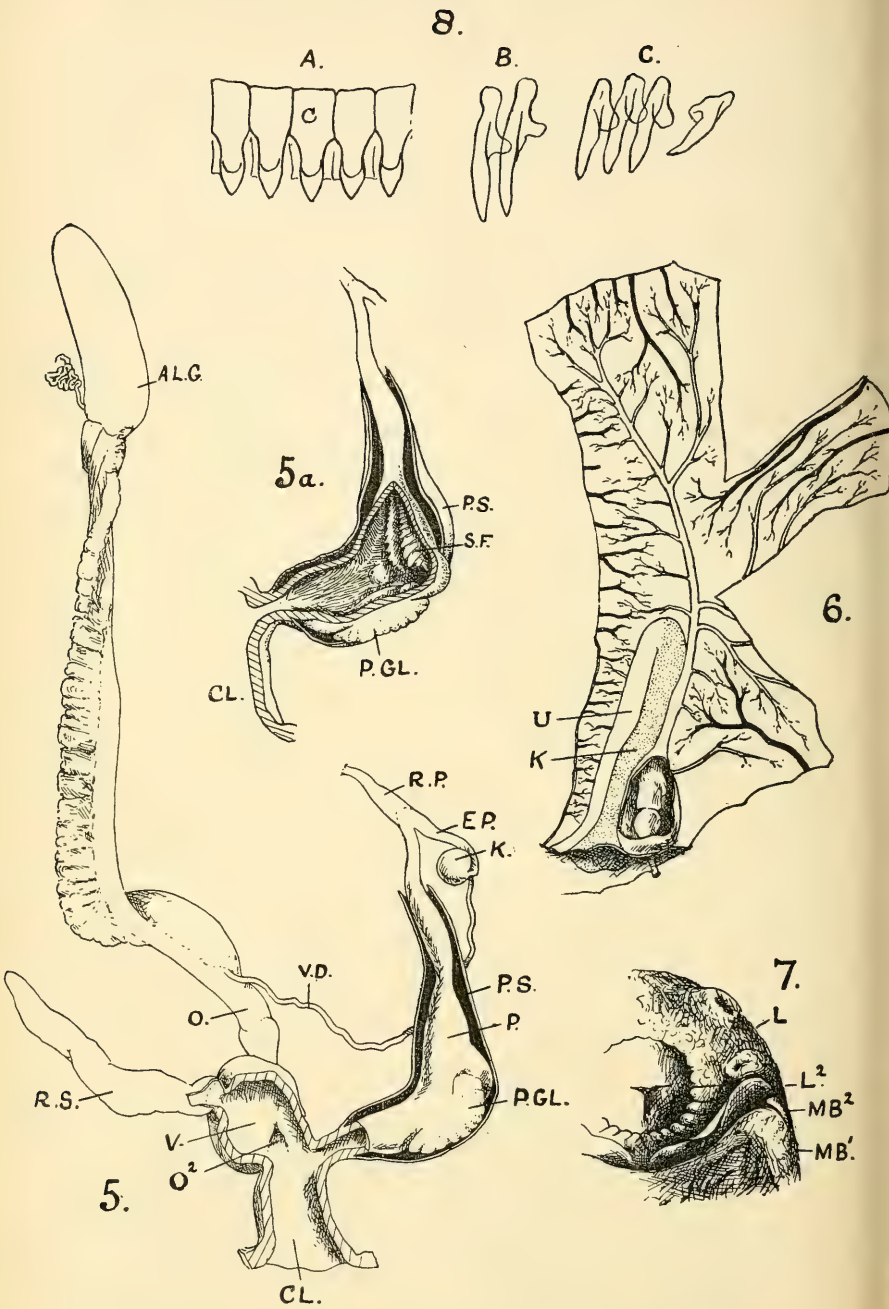
The buccal retractor is completely separate from the rest, except at its actual origin from the shell. Anteriorly it divides into two slips for insertion upon the buccal mass.

The tentacular retractors of each side arise as a single strand from the pedal retractor mass. About the middle of its length the strand divides, the greater part passing to the ocular tentacle, and a smaller slip to the anterior tentacle.

Upon anatomical grounds, and leaving the shell altogether aside, one cannot include this species in the genus *Hemiplecta*, the genus to which the shell is at present referred.

The chief characters upon which this conclusion rests are the absence of shell lobes, the absence of an amatorial organ, the papillate condition of the interior of the penis, and the needle-like marginal teeth of the radula.

On the other hand, the animal in the broad lines of its structure and in many important particulars resembles the members of the Philippine genus *Rhysota*. This is the case as regards the foot and mucous pore, the condition of the mantle-lobes, the general form of the genitalia (compare particularly Semper's figure of the genitalia of *Rhysota ovum*, Reisen im Archipel., Philippinen Landmoll., p. 69, pl. iv, fig. 1), the form of the penis and receptaculum seminis, and the development of papillæ within the penis.



ANATOMY OF RHYSOTA FOULLIOYI.

An important divergence from the condition of the genitalia characteristic of the genus *Rhysota* is, however, shown in the presence upon the vas deferens of a well-developed kalk-sac. In this important particular the genitalia resemble those of *Hemiplecta* rather than of *Rhysota*.

The alimentary tract is similar to that described in the genus *Rhysota*, particularly in the needle-like form of the marginal teeth of the radula, in the nearly straight disposition of the two halves of each transverse row of teeth, and in the form of the buccal mass. The kidney also is not unlike the long strap-shaped kidney described for this genus.

For the above reasons it appears that this snail should be included in the genus *Rhysota* rather than in *Hemiplecta*, although the presence of a kalk-sac suggests that it has closer affinities with *Hemiplecta* than the hitherto known forms of *Rhysota* from the Philippines.

In conclusion, I wish to express my thanks to Colonel Godwin-Austen for help with the literature of the group, and for allowing me to submit my drawings to him and to profit by his experience of the anatomy of Eastern snails.

EXPLANATION OF PLATES VII AND VIII.

PLATE VII.

Anatomy of *Rhysota Foullyoyi*.

- FIG. 1. The hinder part of the foot, from the left. M.B.¹, M.B.², lower and upper borders, M.P. mucous pore.
 ,, 2. The mantle border. L.C.L.¹, L.C.L.² left cervical lobe, R.C.L. right cervical lobe. Rod, in respiratory orifice.
 ,, 3. The retractor muscles, from above. B.R. buccal retractor, P.R. pedal retractor, T.¹R., T.²R. retractors for the two tentacles.
 ,, 4. General view of viscera from above. A.A. anterior aorta, A.L.G. albumen gland, B.D. bile-duct, CL. genital cloaca, H.M.D. hermaphrodite duct, INT. intestine, K. kidney, K.S. kalk-sac, M. mesentery of vas deferens, P. penis, P.C. pericardium, R. rectum, R.P. retractor penis, R.S. receptaculum seminis, S.G. salivary glands, ST. stomach, T.¹, T.² tentacles, U. ureter, V. vagina, V.D. vas deferens; dotted area, liver.
 ,, 4a. Diagram of arrangement of gut coils.

PLATE VIII.

- FIG. 5. The genital organs spread out. The cloaca, vagina, and penis-sheath are opened. EP. epiphallus, O. oviduct, O.² its opening into vagina, P.Gl. glandular bodies on penis, P.S. sheath of penis; other letters as in Fig. 4.
 ,, 5a. The penis, opened. S.F. papillate seminal folds; other letters as in Fig. 5.
 ,, 6. Inner surface of mantle. K. kidney (dotted), U. ureter.
 ,, 7. Anterior view of head. L. beaded circular lip, L.² lateral lip, M.B.¹, M.B.² the two marginal bands of the foot.
 ,, 8. The radula. A. central and admedian, B. lateral, C. marginal teeth.

FURTHER NOTES ON THE DATES OF ISSUE OF THE PARTS
OF SOWERBY'S *CONCHOLOGICAL ILLUSTRATIONS*.

By A. REYNELL.

Read 10th June, 1910.

THE following notes are to supplement Mr. H. O. N. Shaw's paper on the same subject read on March 12, 1909, and had I been aware at the time he had this work in hand I should have been only too glad to have let him have the use of my imperfect copy of the book to have extended his table.

My copy consists of about a hundred complete parts, viz.: 1-20, 25-42, 52-85, 141-70, plates only of parts 173-84 and 185-92.

During the time I was at work on the Mollusca collected by the "Huxley" from the north side of the Bay of Biscay, I had trouble in fixing the date of G. B. Sowerby's description of *Nucula nitida*, which did not seem to be mentioned in any of the many works I referred to. This made me doubt if the dates of issue of the parts of the work under consideration were published or generally known.

I much regret my copy is not complete enough to finish the work Mr. Shaw has begun, but I thought what I could add might be worth publishing.

PART.	DATE OF ISSUE.	GENUS.	FIGURES CONTAINED IN PART.	REMARKS PRINTED ON THE SMALL LIST ACCOMPANYING THE PART AND FURTHER NOTES.
161	Oct., 1839	<i>Chiton</i>	} 68-79	Issued together.
162	Oct., 1839	"		Issued together.
163		"	} 80-6	"A catalogue of the genus
164		"		<i>Chiton</i> will shortly be given."
				A foot-note to fig. 84, <i>Chiton</i>
				<i>spinulosus</i> , Gray: "From a
				finer specimen of the species
				figured in our last part,
				erroneously named <i>C. grani-</i>
				<i>ferus</i> ."
165		"	} 87-113	These seem to have been issued
166		"		together, and with a catalogue
167		"		of British Chitons, on p. 7
168		"		of which is "The following
				British Chitones are contained
				in the Conchological Illustra-
				tions. Parts 165, 166, 167,
				168".
169		"	} 114-25	Issued together.
170		"		"N.B. The next parts of
				Chitones will contain the
				catalogue."
171		"	}	Missing in my copy.
172		"		

PART.	DATE OF ISSUE.	GENUS.	FIGURES CONTAINED IN PART.	REMARKS PRINTED ON THE SMALL LIST ACCOMPANYING THE PART AND FURTHER NOTES.
173		<i>Chiton</i>		} Plates only in my copy.
174		"		
175		"		
176		"		
177		<i>Cardium</i>		} Plates only in my copy.
178		"		
179		"		
180		"		
181		"		} Plates only in my copy.
182		"		
183		"		
184		"		
185	Oct., 1840	<i>Bulinus</i>	} 104-17	Issued together.
186	Oct., 1840	"		
187	Jan. 1, 1841	<i>Murex</i>	} 59-79	Against fig. 77, <i>M. Saulii</i> , nob.: "Some young specimens have been brought by Mr. Cuming from the Philippines." "N.B. A catalogue of this genus is prepared and will shortly appear."
188	Jan. 1, 1841	"		
189	Jan. 1, 1841	"		
190	Jan. 1, 1841	"		
191	Feb., 1841	"	} 80-9	Issued together. Against fig. 83, <i>M. balteatus</i> , Beck, is the foot-note "The beautiful variety here figured was brought by Mr. Cuming from Masbate of the Philip- pines". With these two parts is a leaf paged 9 and 10, giving a corrected list of figures of the Chitons in parts 38-45 and 159-76.
192	Feb., 1841	"		

ON *PETRICOLA*, *LUCINOPSIS*, AND THE FAMILY PETRICOLIDÆ.

By A. J. JUKES-BROWNE, F.R.S., F.G.S.

Read 10th June, 1910.

CONTENTS.

1. Nomenclature and generic types.
2. Description of the shells.
3. Description of the animals.
4. Conclusions.

1. NOMENCLATURE AND GENERIC TYPES.

Before 1853 the genus *Petricola* was included in a family which was generally known as *Lithophaga*, though the group was called Petricolidæ by d'Orbigny in 1837.¹ This family comprised *Saxicava* and *Venerupis* as well as *Petricola*. Gray was the first to restrict the Petricolidæ² and to separate *Saxicava* and *Venerupis* from it, and he recognized two genera, *Petricola* (Lam.) and *Narario* (Gray). In the same year the family was adopted by Deshayes,³ but in the second part of his Catalogue (1854) he added a third genus (*Lajonkairea*⁴), then first proposed for the shells previously known as *Venerupis decussata*, Phil., and *V. substriata*, Mont.

S. P. Woodward in his Manual of the Mollusca (1855) regarded *Petricola* as a member of the Veneridæ and not as the type of a new family, but the Messrs. Adams (1857) adopted Gray's arrangement, except that they substituted *Choristodon* (Jonas) for his *Narario*, and did not recognize *Lajonkairia*.

From that date to the present the Petricolidæ have been generally recognized as a distinct family, the only further separation being that of a sub-genus *Petricolaria* for certain elongate species. Dr. Dall, however, regards a group of shells, separated from *Venerupis* by P. Fischer in 1887⁵ under the name of *Claudiconcha*, as a section or sub-genus of *Petricola*.⁶

In the following pages I shall endeavour to show that *Lucinopsis* (Forb. & Hanl.) ought also to be included in this family Petricolidæ, notwithstanding the different shape of the shell and the habits of the animal.

With regard to *Lajonkairea* the views which different authors have taken are both curious and interesting. Searles Wood regarded the fossil form from the Coralline Crag as a species of *Lucinopsis*, assuming its inclusion in that genus without any discussion of its special characteristics.⁷ Gray & Deshayes made it a genus of Petricolidæ,

¹ *Moll. rec. aux Iles Canaries* (1837), p. 109.

² *Ann. Mag. Nat. Hist.*, vol. xi, p. 38, 1853.

³ *Cat. Bivalve Shells Brit. Mus.*, pt. i, p. 205, 1853.

⁴ Deshayes spelt it *Lajonkairia*, but, being derived from M. de la Jonkaire, under international rules it should be written as *Lajonkairea*.

⁵ *Manuel de Conchyliologie*, p. 1087.

⁶ *Trans. Wagner Free Inst. Sc.*, vol. iii, pt. v, p. 1057, 1900.

⁷ *The Crag Mollusca*, vol. ii, p. 148: Pal. Soc., 1853.

as we have seen (in 1854). Fischer in 1887 placed it as a sub-genus of *Lucinopsis*, but retained that genus in the Veneridæ.

On the other hand, Dr. Dall in 1900 separated it from *Lucinopsis*, and gave the name as one of the synonyms of *Petricola*, remarking that "*Lajonkairea* of Deshayes is close to *Rupellaria*, differing chiefly by more regular striation, absence of strong concentric structure, and rounded rather than pyriform outline". It seems curious that neither Dall nor anyone else should have considered the possibility that *Lucinopsis* might also belong to the Petricolidæ.

Determination of Types.—The type of *Petricola* has been incorrectly given as *P. lithophaga*, because this was the first species cited by Lamarck in 1801;¹ but Dr. Dall has pointed out that Lamarck cited two species, and consequently did not fix the type; further, that in 1802 Fleuriau de Bellevue separated the first species under the name of *Rupellaria*. It is clear, therefore, that Lamarck's second species, the *Venus lapicida* of Chemnitz, is left to form the type of his genus *Petricola*. As this was also the type of Gray's *Narario*, that name consequently becomes a synonym of *Petricola*.

The type of *Choristodon* (Jonas, 1844) is *Ch. typicum*, Jonas, and, in Dr. Dall's opinion, the characters on which it was based are merely pathological. The left anterior and the right posterior teeth are generally separated from their bases by a layer of cartilage, but Dr. Dall thinks this is due to fracture consequent on the teeth having a narrow base. He has found from an examination of a series of specimens that sometimes the teeth are only cracked, and that occasionally they are perfect. In all other respects the shell is similar to that of *P. lithophaga*, and therefore I agree with Dr. Dall that *Choristodon* must rank as a synonym of the *Rupellaria* section of *Petricola*.

The type *Lajonkairea* is the *Venerupis Lajonkairii* of Payraudeau (1826), which Philippi afterwards described as *V. decussata* (1836). When Deshayes instituted the genus *Lajonkairea* he thought himself at liberty to adopt Philippi's specific name instead of duplicating the generic appellation, but this is not allowed by the rules of the Zoological Congress.

The type of *Petricolaria* is *P. pholadiformis*, Lam. This was proposed by Stoliczka for some elongated forms of *Petricola*, which burrow in sand or peat, and have generally a full complement of teeth, three in the left valve and two in the right.

With regard to *Lucinopsis*, there is no doubt as to the type, which is the *Venus undata* of Pennant, but there is much difference of opinion as to the generic name which this type should connote. The facts are as follows. By the earlier conchologists, except Leach, the *V. undata*, Pen., was referred either to *Venus* or *Lucina*, and the name *Lucinopsis* was not given to it till 1853.² Long before this, however, between the years 1816 and 1818, Dr. W. E. Leach appears to have written out a list of British Mollusca, and to have separated some of

¹ *Syst. des An. sans Vert.*, p. 121.

² By Forbes & Hanley, *British Mollusca*, vol. i, p. 433.

them as new genera, giving names to these groups in his MS. He was evidently in communication with Lamarek while the latter was preparing his *Histoire des Animaux sans Vertèbres*, for Lamarek refers to him in many places, and acknowledges the receipt of many specimens from him.

Lamarek's fifth volume of the *Histoire*, containing the list of Conchifera, was published in 1818, and he quotes some of Leach's manuscript generic names in the synonymy of his species, but without adopting them. Thus under his *Amphidesma tenuis* he quotes "*Abra tenuis*, Leach" as a synonym, and under *Lucina undata* (p. 543) he mentions "*Mysia undata*, Leach".

There is, of course, no reference to description or figure after Leach's names, because none had been published by Leach. It is probable that Lamarek quoted Leach's names because he knew that Leach intended to publish them. As a matter of fact they were not published in Leach's lifetime, though J. E. Gray states that part of the MS. was in print in the year 1820. Many years afterwards it came into Gray's hands, and he prepared it for publication by Van Voorst in 1852, under the title of *A Synopsis of the Mollusca of Great Britain*. In this work no such genus as *Mysia* is mentioned, but on p. 313 a genus *Glocomene* is described with one species, *G. Montaguana*, of which *Tellina rotundata* (Mont.) and *T. undata* (Pult.) are given as synonyms; and there can be no doubt that the *T. undata* of Pulteney was the *Venus undata* of Pennant. Thus it is evident that Leach regarded these two species as identical, but that he had abandoned the name of *Mysia* which he had given to Lamarek.

In the meantime, however, T. Brown¹ had used the name *Mysia* in 1827. It is clear that Brown had access to Leach's original MS., for he quotes it by pages many times, and he adopted some of Leach's names. Among others he adopted *Mysia*, with *Tellina rotundata* (Mont.) as the sole representative of the genus, for though he was quite aware that Leach had regarded the *Venus undata* as a *Mysia*, he chose afterwards to follow Lamarek in placing it under *Lucina*.

From the above account it will be seen that Brown was the first to establish the genus *Mysia* on a proper basis, adopting it as his own, and figuring the shell. In my opinion a generic name ought not to be regarded as established by the mere printing of a manuscript name in the work of another author, either in the synonymy of a particular species, or elsewhere. It is to be hoped that the International Commission on Zoological Nomenclature will reconsider their decision on this point; meantime I am glad to be able to state that Dr. F. A. Bather and Mr. Oldfield Thomas agree with the view which I have expressed.

Assuming that this view will be confirmed, I adopt *Lucinopsis* as the proper generic name of *Venus undata* (Pen.); and I may here remark that the name *Mysia* will drop out of conchological literature, because with slightly different spelling (*Mysea*) it was used in 1820

¹ *Illustrations of the Recent Conch. of Gt. Britain*, pl. xvi, fig. 11.

by Billborg for an insect, so that the well-known name *Diplodonta* can be retained for *Tellina rotundata* and its allies.

With regard to *Claudiconcha*, the only species actually mentioned by Fischer in his *Manuel* is *Venerupis monstrosa* (Chem.), which consequently must be taken as the type. I shall also have occasion to discuss the *Veneritapes* of Cossmann, founded in 1886 on the *Venus Bervillei* of Deshayes.

Cooperella is another shell which may have to be included in the Petricolidæ, and the type of this is *C. diaphana*, Carp. According to Dr. Dall,¹ who has examined the types, Carpenter² originally described two varieties of the same species as distinct sections or sub-genera, calling one *Ædalia* and the other *Cooperella*, and regarding the former as the generic type; but as the name *Ædalia* is preoccupied, that of *Cooperella* must stand for the genus. The supposed differences consist only in the degree to which the resilium is sunk, and in the bifidity of the teeth, the extent of which varies in different individuals.

At present only one species of *Cooperella* is known, and that is a common shell on the Californian coast, but Dr. Dall has described a species from the Miocene of Virginia, so that formerly it inhabited the Atlantic Ocean as well as the Pacific.

2. DESCRIPTION OF SHELLS.

Petricola and *Rupellaria*.—A general description applicable to both of these may be given, because both are boring molluscs and clearly belong to the same genus.

In consequence of the boring habit the external shape and sculpture of the shell varies much in different species; but excluding *Petricolaria*, they are either oval or pyriform; there is no lunule nor escutcheon; the ligament is external but generally sunk between the hinge-plates. The internal characters are more definite, though from the descriptions given by different authors it might be thought that they were not. Thus Gray could find only two teeth in each valve; Woodward says "hinge with three teeth in each valve", a statement which is difficult to explain; the Messrs. Adams follow Gray in making two teeth in each valve, "one of which is often obsolete," and Fischer describes the hinge as "carrying two divergent cardinal teeth in each valve, the posterior right and the anterior left being bifid", but he adds "sometimes a rudiment of a third tooth".

The real fact is that the normal number of teeth is three in the left valve and two in the right, and Dr. Dall has rightly recognized this as the true dentition of the genus.³ There is a tendency for the teeth to become irregular and obsolete, as is so often the case in boring Mollusca, so that the number varies in different individuals and in different species. In such circumstances young shells should be examined, and the species which exhibit the larger number and most regular arrangement of teeth should be regarded as representing the normal dentition.

¹ Trans. Wagner Free Inst. Sc., vol. iii, pt. v, p. 1062, 1900.

² Rep. Brit. Assoc. for 1863, pp. 611, 639.

³ Trans. Wagner Free Inst. Sc., vol. iii, pt. v, p. 1056, 1900.

Among the species which I have examined some individuals of the following possess three teeth in the left valve:—

<i>P. bipartita</i> , Desh.	<i>P. robusta</i> , Sowb.
<i>P. typica</i> , Chem.	<i>P. Hemprichi</i> , Issel.
<i>P. lapicida</i> , Chem.	<i>P. æquistriata</i> , Sowb.

In these species the posterior tooth is long, narrow, and parallel to the nymph which supports the sunken ligament, the median is broad and bifid, while the anterior is small with a tendency to disappear in old shells; but all agree in having a peculiar character which does not seem to have been hitherto noticed, this is that the hinge-plate is deeply notched on each side of the median tooth.

In the right valve the usual number of teeth is two, though sometimes (as in *P. lithophaga*) one of these is obsolete, and the complete dentition is reduced to 2-1. The two teeth which are generally present are the posterior and the median, and when only one remains it is the median which survives.

In genera which have three teeth in both valves as in *Chione*, *Tapes*, and *Venerupis*, if attention be paid to the manner in which the teeth interlock, it will be seen that the teeth of the right valve pass in front of those of the left valve, so that the anterior of the right occupies a more forward position than that of the left. The consequence is that if the hinge-area is laterally contracted the right anterior tooth is pushed towards the shell-margin, and tends to become obsolete. In the same way the left posterior cardinal may become merged in the ligamental plate.

This is what has happened in the case of *Petricola*; the right anterior cardinal has become obsolete, and the dental formula of the normal shell is as follows:

L.	0		1.2.3		0
R.	0		0.2.3		0

Further, in some species the posterior teeth of both valves have become obsolete, leaving only a right median to fit between the left anterior and median.

As to other internal characters, it need only be said that the pallial sinus is deep, broadly rounded, and generally ascending, but in some of the *Rupellaria* section it is nearly horizontal.

Petricolaria.—The shells of this group have a similar hinge, but the hinge-plate is so narrow and so deeply notched between the teeth that practically it does not exist, and the teeth seem to spring from the shell-margin. In the right valve the plate is rather broader, and is generally thickened to support the median tooth. There are three narrow teeth in the left valve, the median being only grooved in front, not bifid; in the right valve there are normally two teeth, a broad bifid posterior, and a tall projecting median; no anterior tooth.

The pallial sinus is very deep, often reaching to the middle of the shell, but is nearly horizontal.

Most of the shells belonging to this group are very inequilateral and more or less pholadiform, the umbones being near the anterior end and the posterior region being much elongated; but *P. æquistriata* from Japan is subequilateral and of an elongate-oval shape, and

equally inflated at each end; in fact, it differs in shape from any other species either of *Petricolaria* or *Rupellaria*, and its hinge is more regular with the teeth more divergent.

Lajonkairea.—The shells of *L. Lajonkairea* and *L. substriata* also differ in shape from any of the *Petricola* and *Rupellaria* group, being short and subquadrate, the posterior portion being higher than the anterior, while the reverse is the case in *Petricola*. The hinge, however, is of similar construction, having three teeth in the left valve, the median being widely bifid, and only two in the right valve; but the teeth are more widely divergent than in *Petricola*. The ligament is well developed, but is sunk between the valves so as to be hardly visible from outside. The pallial sinus is large, broad, and ascending. The margins of the valves are smooth in spite of the strong external radial riblets.

Thus there is no doubt that, judging from the shell alone, Gray was right in placing *Lajonkairea* in the Petricolidæ. At the same time Wood & Fischer were equally justified in considering it as closely allied to *Lucinopsis*, and therefore I cannot agree with Dr. Dall in regarding it merely as a *Rupellaria*, and not worthy of separation from *Petricola*.

Moreover, Mons. A. Dollfus assures me that *Lajonkairea* is not a boring mollusc. It generally lives in sand or other soft material, and its shell is then quite regular, but sometimes it harbours in the borings of other molluscs, and then its shell becomes more or less irregular and deformed.

Lucinopsis.—The type of this genus has a thin suborbicular shell, nearly smooth, and only marked by concentric lines of growth. The posterior part is higher and larger than the anterior part. The ligament is externally very long and clearly visible from the outside, being only slightly sunk between the valves. There is no lunule nor escutcheon.

Inside there is a fairly broad hinge-plate bearing in the left valve three close-set but divergent teeth, the central one of which is deeply and broadly bifid; in the right valve there are two divergent teeth which are respectively posterior and central, and sometimes the rudiment of an anterior cardinal can be seen in front of the latter. The pallial sinus is large, deep, and ascending, but rounded at the end.

From the above description it will be seen that the internal characters of *Lucinopsis* are substantially those of *Petricola* and *Lajonkairea*; but the great difference in the shape and texture of the shell seems hitherto to have prevented conchologists from perceiving its real affinities. It is surprising that Fischer, having gone so far as to group *Lajonkairea* as a sub-genus of *Lucinopsis*, did not realize that both of them were more akin to *Petricola* than to *Venerupis* or *Clementia*.

Veneritapes.—It has recently come to my knowledge that the little Eocene shell, described by M. Cossmann in 1886¹ as the type of a new genus under the name of *Veneritapes*, is closely allied to *Lucinopsis*.

¹ Ann. Soc. Roy. Malac. Belge, vol. xxi, p. 104.

I had suspected this to be the case in 1908 from an inspection of M. Cossmann's figure, but did not feel justified in saying so because I had not then been able to examine any specimens. Early in the present year M. Cossmann was kind enough to send me excellent specimens of both valves of this rare and delicate shell, asking me at the same time to give him my opinion of its affinities.

On examining them I found that the hinge closely resembles that of *Lucinopsis*, having three cardinal teeth in the left valve, the posterior one long and narrow, the median triangular and bifid, and the anterior short, prominent, and parallel to the anterior face of the median so that the teeth are divergent. In the right valve there are only posterior and median teeth, the anterior being absent, and the front part of the hinge-plate is concave as in *Lucinopsis* and in *Clementia*. The hinge, in fact, only differs from that of *Lucinopsis* in being more oblique owing to the shape of the shell.

The shell is small, thin, quite smooth and elongate-oval in shape, like so many species of *Tapes*. There is no lunule nor escutcheon, and the ligament appears to have been short and entirely external. The pallial sinus is small and shallow, the pallial line being merely bent inwards posteriorly, so that the siphons of the animal must have been short. On the whole, therefore, though closely allied to *Lucinopsis*, it must be regarded as sufficiently distinct from the type to be considered as a sub-genus, if not a separate genus.

Cyclinella.—So far as I can learn only one species of true *Lucinopsis* is known, the *L. undata* which inhabits the seas of Western Europe, ranging from Norway to the shores of Morocco, and from the Straits of Gibraltar eastward to Italy. The American species which some authors had referred to *Lucinopsis*, and others to *Cyclina*, were separated by Dr. Dall in 1902¹ under the name of *Cyclinella*, because they had three teeth in each valve.

The type of *Cyclinella* is *C. tenuis* (Récluz), and though in shape it greatly resembles *Lucinopsis*, it has a stouter shell and a circumscribed, though not impressed, lunule. In the left valve the median tooth is thick, but not bifid, and the posterior is curved not straight as in *Lucinopsis*. In the right valve there are also three teeth, the posterior long, curved, and bifid, the median thick and triangular, the anterior small, narrow, and straight. The pallial sinus is deep and ascending, but narrow, and bluntly pointed, so that it differs much from the broad and rounded sinus of *Lucinopsis*.

In all respects both internal and external *Cyclinella* resembles *Cyclina* much more closely than it does *Lucinopsis*, the only important difference being the radial structure of the shell in *Cyclina*, which, though feebly marked outside, is strong enough to crenulate the inner margin of the shell.

On the whole my opinion is that *Cyclinella tenuis* belongs to the Veneridæ, and I shall be surprised if the animal, when properly examined from fresh specimens, does not confirm this view. Dr. Dall himself regarded it as forming a separate genus from *Lucinopsis*, and

¹ The *Nautilus*, vol. xvi, p. 44.

on this point I quite agree; but whether it should be generically separated from *Cyclina* only a comparison of the animals can decide. At any rate I shall not include *Cyclinella* in the Petricolidæ.

Claudiconcha.—The species referred to this group had always been referred to *Venerupis*, and Fischer in his *Manuel de Conchyliologie* (1887) only separated them as a section of that genus, giving *V. monstrosa* (Chem.) as a single example, which therefore may be taken as the type. Dr. Dall, however, regards them as a section of *Petricola*, remarking, "Lastly we have boring species in which the natural inequality of the valves is exaggerated and the margin of the right valve in full-grown specimens is irregularly expanded, overlapping that of the left valve which remains normal, and frequently forming channels in which the siphons lay or may be extended. For these forms, erroneously referred to *Venerupis*, Fischer has proposed the subgeneric name of *Claudiconcha*."

Dr. Dall does not explain why these species should not be referred to *Venerupis*, but he asserts them to be boring shells, whereas *Venerupis* is not. He says nothing about the animal, nor does either he or Fischer mention any other species beside *V. monstrosa*. If he had evidence that this species was a borer, he should have stated it, for the expansion and upturning of the posterior portion of the right valve is very difficult to reconcile with the idea that the animal made the hole in which it is found; on the contrary it is just the sort of deformation that one would expect in a nestler like *Venerupis*.

On application to Messrs. Sowerby & Fulton they supplied me with a specimen of *Cl. monstrosa*, and specimens of two other species which they supposed to belong to *Claudiconcha*. These were *V. madreporaria* and *V. Cumingi* (Desh.). The last mentioned is, however, unquestionably a *Venerupis*, having three distinct teeth in the right valve as well as the left.

C. monstrosa has in the left valve three teeth, small nearly equal teeth, smooth and pustular, not bifid, and much more resembling those of *Venerupis* than those of *Petricola*. The right valve has only two teeth in the adult, but this may be the result of deformation and compression, for I have specimens of *V. irus*, both young and old, in which the anterior tooth is obsolete, so that the number of teeth is then the same as in *C. monstrosa*.

In *V. madreporaria* the dentition is like that of *C. monstrosa*, except that the left median is broad and is bifid in young shells. In size and variability of shape this species resembles *V. irus*.

So far as I can judge from these few specimens it seems very doubtful whether *Claudiconcha* should be transferred from *Venerupis* to *Petricola*.

The *Cooperella* of Carpenter probably does belong to the Petricolidæ, but is certainly rather more abnormal than *Lucinopsis*, which it resembles in certain respects.

The shell is small, about half an inch long, very thin, nearly smooth, but concentrically undulated, and feebly striated; nearly equilateral, without lunule or escutcheon. There is a short narrow external ligament, which is continuous with a posterior resilium, sunk and

supported by a shelly plate behind the teeth. The hinge-plate is narrow, delicate, and excavated, bearing three teeth in the left valve and two in the right. The teeth are all narrow, prominent, and near together, hardly divergent; the left central and posterior being grooved, but not exactly bifid in any I have seen. The pallial line has a long deep sinus.

Dr. Dall created a separate family for this genus in the memoir above cited, but gave no reason for so doing, leaving us to suppose that he regarded the presence of a semi-internal resilium and very thin shell as characters of family importance. For such separation I see no necessity, though I agree with him as to the close affinity of *Cooperella* with the Petricolidæ.

3. DESCRIPTION OF ANIMALS.

Petricola.—I cannot find that anyone has yet described the animal of the small typical section of *Petricola*, which was called *Narario* by Gray. Writing in 1853 he says of it "animal ignotum"; but probably it resembles that of the *Rupellaria* section.

Rupellaria.—The descriptions of the animal of *Petricola* given by S. P. Woodward and the Messrs. Adams doubtless refer to the Mediterranean species *P. lithophaga*. They say the mantle is closed in front, thickened and recurved over the edges of the shell; the siphons are separate for the greater part of their length; the foot is small, compressed, and lanceolate, with a byssal groove on the lower margin.

These characters are evidently correlated with the boring habit of the animal; the foot being small, because there is small use for it in the limited space within which the animal lives.

Petricolaria.—The animal of this group is similar to that of *Rupellaria*, but is, of course, much elongated posteriorly. The foot, however, is much larger, a fact which seems to indicate that the animal has freer movement within its soft-walled burrow, and uses its foot as a fulcrum. The siphons are separate, divergent, and remarkably long.

Lajonkaira.—The only description which I have been able to find of this animal is that given by Deshayes in Latin,¹ of which the following is a translation:—"Mantle entire, open in front, closed below and behind; siphons two, united to one another, somewhat compressed, subequal, the branchial siphon larger, and ciliated at the orifice. Foot small, compressed, linguiform. Labial appendages long, narrow, pointed, and triangular."

Lucinopsis.—As no very complete description of the animal of this genus has been published, I give the following from observation of Torbay specimens:—Animal suborbicular, mantle closed, except for a small foot-opening, margins smooth. The foot is small, laterally compressed, and broadly attached to the body; it does not show any byssal groove. The siphons are very long, entirely separate, divergent,

¹ Cat. Bivalve Shells in Brit. Mus., pt. ii, p. 217, 1854.

and the orifices of both are fringed with small tentacles. Labial appendages rather small, triangular.

Comparing the above description with that of *Lajonkairea* it will be seen that while the animals agree in the characters of mantle and foot, they differ entirely in the siphons, which are free in the one and united in the other.

Cooperella.—The animal of this has been described by Dr. Dall in the following terms:—"Siphons long, slender, separate, the branchial fringed at its orifice; mantle margins simple, free for about half the length of the shell; gills rather small, free, with direct and reflected inner and outer laminae; palpi very small; foot compressed quadrate, without any byssal groove or obvious gland."

It will be seen that the animal, like the shell, has considerable resemblance to *Lucinopsis*, but that the mantle is much more widely open in front.

Claudiconcha.—I have not been able to find any special description of the animal of *Venerupis montrosa*, and until its characters and habits are known, especially whether it is really a rock-borer or not, its generic affinities cannot be determined.

4. CONCLUSIONS.

Reviewing the preceding descriptions and observations, I conclude that the genus *Petricola* should be restricted to what may be called the two typical sections, i.e. the *Narario* of Gray and the *Rupellaria* of Bellevue, with *Petricolaria* as a sub-genus.

In this genus we have a group of boring molluscs, and consequently both animal and shell have been modified in accordance with this habit. I have no doubt that the original stock from which *Petricola* sprang was a form which merely burrowed in firm sand or stiff mud, in the same manner as *Lajonkairea* does at the present day. When for greater security the ancestral form took to excavating harder material, the frontal portion of the mantle would be developed to a greater extent, and the enlargement of the anterior portion of the shell may be correlated with the enlargement of the mantle tissue.

Lajonkairea seems to stand by itself. It is not a boring mollusc, and its usual habitat is believed to be hard sand, but sometimes it harbours in the rock-burrows of other molluscs, just as *Venerupis* does. It differs much from *Petricola* both in shell and in animal. The siphons are united to their ends instead of being largely separate as in *Petricola*; while the shell has a fuller and higher posterior than anterior development, and the hinge has more divergent teeth in spite of the fact that the shell is shorter. In view of these differences I think it should form a distinct genus, separate both from *Petricola* and *Lucinopsis*.

With regard to *Lucinopsis* we have seen that its internal characters, and especially the hinge, agree closely with those of *Petricola*. Its external shape is, of course, very different, but in this respect it may be compared with *Dosinia*, *Cyclina*, and *Cyclinella*, which are all free shells, burrowing in sand, while other members of the Veneridæ are elongate-oval in shape.

Though *Lucinopsis* is closely related to *Lajonkairea*, the separated siphons, their great length, and the correspondingly long ascending pallial sinus seem to prevent its being placed in the same genus. The shell, too, is thinner, and there is an entire absence of radial structure and of external sculpture.

With *Lucinopsis*, and as a sub-genus, I would place the *Veneritapes* of Cossmann for the reasons already given. With regard to *Cooperella* it seems to me to come very near these two forms, and as the internal resilium is very variable in its development, so that it is sometimes merely an extension of the ligament, the differences in the shell are small. The mantle of the animal is much more widely open than in the case of *Lucinopsis*, and some observers may regard this as a generic character. Dr. Dall is evidently of this opinion, and in deference to it I retain *Cooperella* as a genus.

Cyclinella and *Claudiconcha* I provisionally exclude from the family because there is not yet sufficient evidence for removing the one from *Cyclina* and the other from *Venerupis*. The Petricolidæ may therefore be regarded as consisting of the following generic and sub-generic groups:—

GENERA.		SUB-GENERA.
<i>Petricola</i> , <i>Lajonkairea</i> .	with	<i>Petricolaria</i> .
<i>Lucinopsis</i> , <i>Cooperella</i> .	with	<i>Veneritapes</i> .

ORDINARY MEETING.

FRIDAY, 11TH NOVEMBER, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The following communications were read:—

1. "Descriptions of new Melaniidæ from Goram and Kei Islands, Malay Archipelago." By H. B. Preston, F.Z.S.
2. "On the Anatomy of the British species of the genus *Psammobia*." By H. H. Bloomer, F.L.S.
3. "Note on *Triton tessellatus*, Reeve." By Major A. J. Peile, R.A.
4. "Note on the Animal of the genus *Cleopatra*." By E. A. Smith, I.S.O.

Mr. H. B. Preston exhibited living specimens of *Cleopatra ferruginea*, and *C. cingulata* from British East Africa.

Mr. G. C. Crick exhibited twenty-two more or less imperfect examples of either the alveolar ends or the infilling of the alveolus of *Belemnites Oweni* from the Oxford Clay at Fletton, near Peterborough, each being associated with a Pelecypod (*Nucula*) in such a manner as to show that the bivalve had occupied the alveolus of the Belemnite guard. The specimens were sent to the British Museum by Mr. Thomas Ploughman, who stated that all were obtained on one occasion, and that very few bivalves were found separately in the clay. From the fact (1) that the shells did not belong to parasitic commensal or boring molluscs; (2) that they were usually inserted into the cavity as far as their size would permit, with sometimes the anterior and sometimes the posterior end of the shell towards the point of the alveolus; (3) that they were all situated below the position which the soft parts of the Belemnite would occupy; and (4) that in one case, at least, the infilling of the alveolus contained also a portion of the small guard of another Belemnite, the consensus of opinion of the members present was that, notwithstanding the frequency of their occurrence, they were accidentally washed into the alveoli of the guards after the death of the Belemnites, and subsequent detachment of their soft parts and of the greater portion, or in most cases of the whole, of the phragmocone.

The Rev. R. Ashington Bullen exhibited a species of *Arca* with irregular pearl-like growths inside; *Crepidula* sp., found in guano from Arica; living specimens of *Clausilia parvula*, *Hygromia hispida*, *Hartmannia patula*, and *Pupa quadridens*, all from Rosamadour, Lot, France; a dwarf form of *Helicigona lapicida*, from Cauterets, Hautes Pyrenées, France, alt. 5,000 feet.

ORDINARY MEETING.

FRIDAY, 9TH DECEMBER, 1910.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Dr. Annandale, The Superintendent, Indian Museum, Calcutta, Dr. Fritz Haas, A. W. Rogers, M.A., D.Sc., G. H. Tipper, A. F. Bassett Hull, and Henrick Sell were elected members of the Society.

The following communications were read:—

1. "On the names used by Bolten and Da Costa for genera of Veneridæ." By A. J. Jukes-Browne, F.R.S., F.G.S.
2. "Note on a new Armorican locality for *Elna Quimperiana*, Fér." By H. B. Preston, F.Z.S.
3. "On some Misapplied Molluscan Generic Names." By T. Iredale.
4. "Note on *Chiton Torri*." By Charles Hedley, F.L.S.

ORDINARY MEETING.

FRIDAY, 13TH JANUARY, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Dr. Henry Woodward and Mr. S. Pace were appointed auditors.

Messrs. A. D. Archangelsky and A. W. Pavlow were elected members of the Society.

The following communications were read:—

1. "A Collation of J. C. Chenu's Illustrations Conchyliologiques and a note on P. L. Duclos' Hist. Nat. gén. et part. Coquilles." By C. Davies Sherborn, F.Z.S., and E. A. Smith, I.S.O.
2. "Description of a new species of *Pachychilus* from Cuba." By H. B. Preston, F.Z.S.
3. "Description of a new species of *Helicodonta* from Tenerife." By G. K. Gude, F.Z.S.
4. "Note on some preoccupied molluscan generic names and proposed new genera of the family Zonitidæ." By G. K. Gude, F.Z.S.

Mr. G. B. Sowerby exhibited a specimen of *Voluta Prevostiana*, Crosse, of abnormal size (8 inches long); a specimen of *Voluta Deshayesii*, Reeve, without angular nodules, and *Cymbium diadema* without spines.

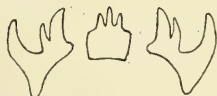
Mr. E. A. Smith exhibited an abnormal shell of *Strombus gigas*, from Great Abaco Island, Bahamas, having an elongated channelled spire and a prominent sub-tuberculed keel round the middle of the body-whorl; also a sinistral specimen of *Vasum rhinoceros*. He pointed out that *V. cassidiiformis*, lumped with this species by Tryon, is quite distinct.

Mr. A. S. Kennard exhibited an interesting example of a species of *Unio* taken alive by Mr. Harrington in 1906 in the Thames at Maidenhead. Its identification was not definitely determined.

NOTES.

NOTE ON *TRITON TESSELLATUS*, REEVE. (Read 11th November, 1910.)
—A discussion having arisen as to the proper classification of the species hitherto known to me as *Epidromus tessellatus* (Reeve), Mr. E. G. Vanatta, on being informed of the character of the radula, kindly drew my attention to a paper published by Dr. H. A. Pilsbry and himself in the Proc. Acad. Nat. Sci. Philadelphia, vol. lvi, pp. 592-5, 1904.

This deals with "Certain Rhachiglossate Gastropoda eliminated from the Aquillidæ" and placed in the subgenera *Maculotriton*, Dall (Muricidæ), and *Caducifer*, Dall (Buccinidæ).



The radula of our present species determines it to belong to the second of these groups. The radula here figured, and specimens of the shell collected by me in Bermuda, are now in the British Museum. The habits of the animal are similar to those of *Tritonidea tinctoria*, Conrad, from the same locality. They both occur under stones between tide-marks.

Reeve's type in the Cuming Collection was described as from the Island of Burias, Philippines. This locality has, however, never been confirmed, and it is probably incorrect. The Museum also has specimens from St. Thomas.

Tryon (Man. Conch., vol. iii, p. 30) considered the present species synonymous with *Triton concinnus* of Reeve. Examination of the type of the latter, also in the British Museum, shows that they are distinct.

A. J. PEILE.

NOTE ON *CHITON TORRI*. (Read 9th December, 1910.)—*Chiton Torri*, Hedley & Hull, 1909, but not of Suter, 1907, was renamed *Chiton Hullianus* by Mr. T. Iredale (Proc. Malac. Soc., vol. ix, p. 103, June, 1910). Unfortunately the original authors had already detected the synonym and proposed *Chiton Torrianus*,¹ Hedley & Hull (Records Australian Museum, vol. viii, corrections p. xi, published 28th February, 1910). C. HEDLEY.

NOTE ON A NEW ARMORICAN LOCALITY FOR *ELONA QUIMPERIANA*, FÉR.
(Read 9th December, 1910.)—The object of the present note is to place on record a new locality for that curious and extremely local Helicoid *Elona Quimperiana*, Fér., viz. the Chapel of Ste. Barbe, about two miles from Le Faouët in the Department of Morbihan, and about twenty miles from the nearest point on the coast; the only other localities in Morbihan where it has been previously noticed being Lorient, le Tour d'Elven, and Lanveaux; in Finisterre it occurs at Quimper, Quimperlé, Brest, Landevenec, Lanveoc, Saint Marc, Plougastel, and St. Pierre Quilbignon, while it has recently been taken by Monsieur F. Kerforne in the Forêt de Lorges in the Côtes du Nord²; it has also been collected in various localities in the Pyrenees, and at several places in the North of Spain. It seems probable, therefore, that when the Armorican Peninsula is more thoroughly searched from a conchological point of view, the species, though always a local one, may prove to be more widely distributed than it is at present thought to be.

H. B. PRESTON.

¹ [Mr. Iredale has already employed the name *C. Torrianus* in place of *C. Hullianus*, Proc. Malac. Soc., vol. ix, p. 758.—ED.]

² Rennes, Bul. Soc. Sci. Med., vol. xvii, pp. 177-8.

DESCRIPTIONS OF NEW MELANIIDÆ FROM GORAM AND KEI ISLANDS, MALAY ARCHIPELAGO.

By H. B. PRESTON, F.Z.S.

Read 11th November, 1910.

MELANIA GORAMENSIS, n.sp.

Shell small, cylindrical, black, striate at the base; spire abruptly decollate by process of erosion; remaining whorls $4\frac{1}{2}$, flat, marked with irregular transverse growth-lines, and sculptured with indistinct, rather distant spiral striæ, the last whorl bluntly angled below; sutures impressed; columella slightly arched, livid, diffused into



a callus which joins the lip above; labrum somewhat sinuous, acute; aperture elongately ovate; interior of shell, near the labrum, bluish black, shading to olive further within. Alt. 11.25 mm.; diam. maj. 4.25, min. 4 mm.; aperture, alt. 4, diam. 2 mm.

Hab.—Goram Island, Malay Archipelago.

MELANIA STALKERI, n.sp.

Shell subulate, pale yellowish horn colour, blotched and spotted with reddish purple, and covered with a thick opaque black incrustation; spire eroded; remaining whorls 9, gradually increasing, slightly convex below, marked with lines of growth, and spirally striate, the spirals having a beaded appearance on the last two whorls; sutures impressed, narrowly margined below; columella white, arched, with a black, polished, and minutely pitted callus joining it with the lip above; labrum acute, aperture elongately auriform; interior of



shell livid dark bluish grey; operculum laminiferous, with basal nucleus. Alt. 44·5 mm.; diam. maj. 12·5, diam. min. 10·5 mm.; aperture, alt. 14·25, diam. maj. 6·5 mm.

Hab.—Goram Island, Malay Archipelago.

Differing from *M. fulgida*, Reeve, in not having the concave outline of the spire of that species; moreover, the upper whorls are not costate, and the spiral striæ are beaded on the last two whorls, a character which also differentiates it from *M. Aruensis*, Reeve.

MELANIA KEIENSIS, n.sp.

Shell turbinately fusiform, reddish brown, painted, especially on the lower portion of the body-whorl, with transverse bands of dark chestnut; whorls 8, sculptured with coarse spiral and fine transverse striæ, transversely costate, the costæ, especially on the penultimate and antepenultimate whorls, being developed into almost spiny nodules at a point about two-thirds of their total length; the lower half of the



last whorl and base of shell rather coarsely grooved; sutures impressed, faintly crenellate; columella straight, diffused into a thin callus which reaches the lip above; labrum acute; aperture ovate. Alt. 11·5 mm.; diam. maj. 5·5, diam. min. 4·75 mm.; aperture, alt. 4·5, diam. 2·25 mm.

Hab.—Kei Islands, Malay Archipelago.

DESCRIPTION OF A NEW SPECIES OF *PACHYCHILUS* FROM CUBA.

By H. B. PRESTON, F.Z.S.

Read 13th January, 1911.

PACHYCHILUS VIOLACEUS, n.sp.

Shell subulate, moderately solid, black; remaining whorls 4, rather flat, sculptured with very fine, wavy, spiral striæ; sutures impressed; columella arched, violet, diffused above into a thin callus, and thickening into a white, minutely granular protuberance just below the point of insertion of the labrum with the parietal wall; labrum thin, acute, sinuous, bluish white on the inner side; aperture rather broadly inversely auriform; interior of shell violet, showing traces of a white, peripheral, spiral band; operculum having 4 whorls, laminiferous, with sub-central nucleus. Alt. 35, diam. maj. 16 mm.; aperture, alt. 18, diam. 7 mm.

Hab.—Cuba, at an altitude of 2,300 feet.

Perhaps it would not be out of place to note here the fact that a genus of Coleoptera, '*Pachychila*,' was founded in 1831, some twenty-six years previous to the creation by Lea of '*Pachychilus*'



in Mollusca; according, however, to the rules laid down by the International Congress of Zoology (1905, p. 39) both names may stand, though, unfortunately, so nearly similar.

ON THE ANATOMY OF THE BRITISH SPECIES OF THE GENUS
PSAMMOBIA.

By H. H. BLOOMER, F.L.S.

Read 11th November, 1910.

PLATES IX AND X.

PSAMMOBIA VESPERTINA (Chemnitz).

The animal, in a quiescent state, lies with the valves of the shell a little agape, the adductor muscles partly relaxed, and the pallial lobes, excepting near the beak and ligament, protruding some distance beyond the edge of the shell, especially those portions bordering the pedal aperture (Fig. 1). Externally nearly the whole of the projecting parts is covered with the usual dusky-brown periostracum, which passes from the shell to near the mantle-fringe. In a normal condition the free edge of the lobes curves inwardly, so that the fringe is not often exposed to view. The exposure, however, may take place immediately preceding and during the process of moving, when the animal approaches complete expansion, and the pallial margin is uncurved.

The foot (Fig. 2, *F*.) is of a milk-white colour, very muscular, yet very sensitive. It can be protruded a great distance, and shows considerable power of mobility, projecting from any part of and moving all along the pedal aperture, bending from side to side, swelling or contracting, lengthening or shortening, and capable, either rapidly or slowly, of continually changing its shape and position. From my own observation the mode of locomotion is either by leaping or creeping, and in this function the foot plays the principal part. In leaping the foot is pushed out anteriorly with a slow, undulatory movement; whilst lengthening, the distal end bends, and passes underneath the other portion, then, with great rapidity and muscular force, it is straightened, and the animal thrown forwards. On the other hand, the foot may be thrust out sideways, passed underneath the shell, and with the same action the animal is turned over or sent some distance laterally.

In creeping, the distal end of the extended foot seizes the ground, contracts, and draws the body along. It is possible that this species also swims in the same manner as the smaller ones, but I have never seen it do so.

External Characters.—An average-sized animal measures about 52 mm. antero-posteriorly by 28 mm. dorso-ventrally. Dorsally it is curved with a depression under the hinge region. The other sides are likewise curved, except the postero-ventral part, which is angular, and projects more posteriorly than any other portion.

The pallium, or mantle, is a thin membrane covering bordered by a muscular band, decreasing in depth as it passes rearwardly. The pedal aperture reaches from the anterior adductor muscle to the musculus cruciformis, consequently, between these two points

the apposed mantle-edges nowhere coalesce, but near the latter muscle the inner longitudinal fold, or velum, of the one mantle-lobe becomes fused with that of the other lobe. The united part then diverges from its relative position to the pallial edge, and, proceeding dorsally, separates only to become connected on each side with the lateral walls of the siphon. The apposed folds again become fused, and afterwards pass around the posterior and dorsal parts of the posterior adductor muscle. Thus the posterior portion of the pallial cavity is completely enclosed with the exception of the siphonal apertures. The inner longitudinal folds are also fused over the anterior (Fig. 5) as well as the posterior adductor muscle, and consequently form the covering of these muscles. Fig. 6 presents typical mucus glands of this portion of the pallium, and their ducts will be seen passing between the epithelial cells to the outer surface. Mucus glands, cells, or masses are present all round the inner surface of the mantle-lobes just above or below the velum. The pallium is apparently perforated by both the large adductor muscles, and its line of attachment passes on each side from the anterior adductor to the body of the animal, ascending as it goes rearwardly until over the branchia, where it is near the dorsal surface, then, descending, it skirts the edge of the posterior adductor muscle. Each mantle-lobe carries a tentacular fringe at the distal edge of the middle longitudinal fold.

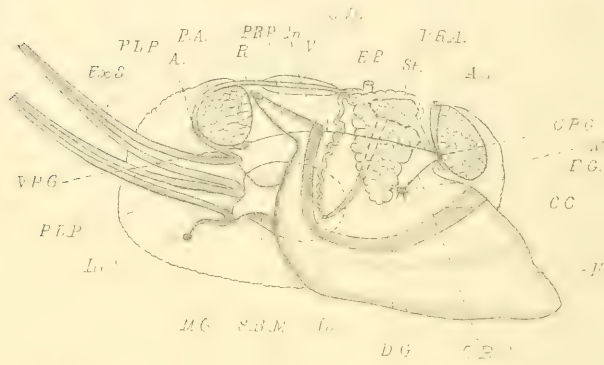
Underneath the posterior adductor muscle is situated the siphon. It consists of two long tubes (Fig. 2, *Ex.S.* and *In.S.*) capable of great elongation and contraction. The lower or inhalent is longer than the upper or exhalent one, and, in an extended condition, both, at the free end, usually curve upwards. The lower portion of the proximal part of the exhalent tube is united with the upper portion of the inhalent one, and the combined part (Fig. 2, *S.R.M.*) projects some distance into the pallial cavity. On each side of the animal the siphonal muscles are continued as a short thick muscle which penetrates the thin membranous pallial wall, and spreads out into a large flat ovate-shaped disc, with its external surface attached to the shell. Each tube generally carries at its extreme free edge six papillæ, whilst along the external surface is a corresponding number of rows of them, each row being in alignment with one of the papillæ at the free end. The position of each row is radially in a line with one of the internally arched muscle-masses mentioned farther on. It is further to be observed that the pallial lobes extend some distance posteriorly beyond the proximal portion of the siphon, and the siphonal tubes can be quite withdrawn between them (Fig. 2, *P.L.P.*). In this state the posterior portion of the branchia is forced into a folded position.

Pallial Muscles.—The muscles of the pallial edge form a band, diminishing in depth as it proceeds posteriorly. They consist principally of transverse muscle-fibres, radiating as from the umbonal region to the edge of the pallium, and longitudinal ones running chiefly near and parallel to the circumpallial edge.

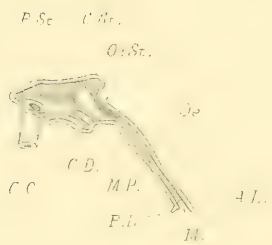
The siphonal tubes proximally become somewhat flattened. Their muscular wall is composed of five coats, alternately circular and



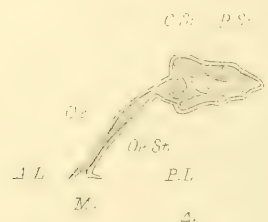
1.



2.



3.



4.



5.



6.

longitudinal in direction, beginning from the outside. The outer longitudinal muscles form a broad band, whilst the inner longitudinal ones are grouped into six semicircular masses facing inwards. Running from the outer to the inner annular band are a number of muscle-fibres constituting the transverse muscles which pass between the longitudinal muscles and through the middle annular band. At the proximal end of each lateral side the muscles of the siphonal tubes are drawn together into a short rounded muscle, which quickly spreads out into a large disc and forms the enlarged portion of the siphonal retractor muscle that is inserted into the shell. As before mentioned, the siphonal tubes are capable of not only great elongation but also of great contraction. In the latter case the contracted tubes often widen to large dimensions, whilst the proximal portions are partly introverted into the pedal cavity.

The anterior adductor muscle (Fig. 2, *A.A.*) is wide, convex on the dorso-anterior surface, slightly concave on the ventro-posterior surface, and spreads out towards the ends, which conform to the curvature of the shell. On the convex surface it is attached to the pallium, and on the dorso-posterior surface to the anterior retractor and anterior protractor muscles.

The posterior adductor (Fig. 2, *P.A.*) is a large muscle spreading out towards the ends, and likewise conforming to the convexity of the shell. It is attached to the pallium, except at the antero-dorsal surface, where the bifurcations of the retractor pedis posterior muscle rest upon it.

The musculus cruciformis (Fig. 2, *M.C.*) situated at the postero-ventral edge of the pallium, and ventrally to the posterior adductor muscle, is divided at each end into two branches. One branch proceeds some distance anteriorly and buries itself in the mantle-lobe, then, emerging on the outside, is inserted into the shell. The other branch goes some distance dorso-posteriorly, and in a like manner also becomes attached to the shell.

Pedal Muscles.—The foot (Fig. 2, *F.*) is large, very muscular, and capable of great expansion. The intrinsic muscles are annular, longitudinal, and transverse. The annular muscles constitute the pedal integument, and near its lateral inside walls run the powerful longitudinal muscles which traverse nearly the whole length of the foot, whilst passing from side to side are transverse muscle bundles; in the proximal part they are of some length and pass through the viscera, the ends spreading out and going between the longitudinal muscles to the integument; in the middle of the foot they also occupy the central area, having spaces between them which form the pedal sinus, but towards the distal end they, together with the longitudinal ones, fray out, resulting in a large muscular meshwork.

The retractor pedis anterior muscles (Fig. 2, *P.R.A.*) are short and thick, but not bifurcated; they pass dorsally along the rear side of the anterior adductor muscle, and are inserted into the shell close to the latter, and the fibres of their proximal part pass ventrally through the foot, spreading out fan-shaped.

The protractor pedis anterior muscles are large but short, and

adhere laterally to the sides of the shell, whilst anteriorly they are connected with the anterior adductor muscle. Proximally their fibres pass over those of the retractor pedis anterior muscles, and terminate in the pedal integument.

The retractor pedis posterior muscle (Fig. 2, *P.R.P.*) is also thick and short, with its two short bifurcations lying on the antero-dorsal surface of the posterior adductor muscle, and its distal ends attached to the shell, in close proximity to the adductor muscle. The fibres of its proximal part are traceable running in a longitudinal direction just inside the pedal integument.

The elevator pedis muscles are situated anteriorly to the centre of the dorsal edge of the foot, and their muscle-fibres are likewise soon buried in the pedal integument.

Alimentary Canal.—The mouth (Figs. 3 and 4, *A.A.*) is situated on the ventral surface close to the anterior adductor muscle, and is bordered by the lips which are continued laterally as the labial palps (Figs. 3 and 4, *A.L.* and *P.L.*). The œsophagus (Figs. 3 and 4, *Oe.*) is long and dilated from the centre to near the stomach. Its length and direction (the latter being more or less dorso-posteriorly) depend upon the expansion or contraction of the foot. The stomach (Figs. 2, 3, and 4, *St.*) is an irregularly shaped and several-lobed sac occupying the dorsal part of the visceral mass, and surrounded by the digestive gland or liver (Fig. 2, *D.G.*). It may be conveniently separated into the following divisions, œsophageal, cardiac, central, and pyloric, each being distinguished from the others by an internal raising or folding of the gastric wall, or the varying length of the cells of the epithelial lining. The œsophageal division (Figs. 3 and 4, *Oe.St.*) is small; it opens into the œsophagus at the fore-end, and posteriorly is bordered by the folded gastric wall, which here culminates in a very prominent process, separating it from the cardiac division. The cardiac division (Figs. 3 and 4, *C.St.*) is small, and continues on the left side as a deep pocket-shaped cavity. On the right side its separation from the pyloric division is indistinct. The above-mentioned process is a large and wide projection from the left side of the stomach between the various divisions, and is supported by a dense mass of fibrous connective tissue. The cells of the epithelium lining this and the adjacent parts of the stomach are extremely long and narrow. Under this process is the central division (Fig. 3, *C.D.*), a small round cavity receiving the large duct from the digestive gland. The pyloric division (Figs. 3 and 4, *P.St.*) is large, and embraces the greater portion of the stomach. On its ventral surface, towards the rear end, it is continued as a very long, slightly posteriorly, curved sac, the cæcum of the crystalline style (Fig. 3, *C.C.*). The crystalline style extends all along the cæcum, bends anteriorly on entering the stomach, and stretches along it to the anterior wall, frequently at this point it curves, and nearly fills the cardiac division as well.

Covering the floor of the stomach and entering the different cavities is a gelatinous mass, the flèche tricuspidæ, which, when stained with Ehrlich's hæmatoxylin, appears to be quite structureless, whilst the neighbouring crystalline style exhibits certain concentric markings,

and in the centre the matrix has, under high magnification, a mottled appearance.

Fig. 7 is a transverse section of the cæcum of the crystalline style and intestine, and shows the epithelium of the former to contain long columnar cells with the nuclei near the centre, and the free ends carrying a mass of long cilia. The cells increase in length as they approach the passage leading to the intestine. This passage apparently can be closed by a prolongation of the divisional wall which projects into the lumen of the intestine. In the same figure can be seen the typhlosole in the ascending intestine.

As the cæcum of the crystalline style and the fore-part of the intestine are in one piece, the latter has the appearance of being a somewhat constricted groove on the left side, and the intestinal wall only becomes complete at the distal end of the cæcum. The intestine turns dorsally, its wall is invaginated, forming the typhlosole, and near the posterior part of the stomach makes a number of folds; afterwards, turning posteriorly, it proceeds as the rectum, and is shortly encircled by the ventricle. It then passes over and partly round the posterior adductor muscle, enters the pallial chamber, and terminates with a small anus.

The digestive gland surrounds the stomach, but the greater portion lies ventrally to it. The large duct enters the central division from the right and larger lobe, and the other duct from the left and smaller lobe enters the anterior end of the pyloric division on the left side.

The renal organs, which are of an orange-red colour, are situated on the outside and over the pedis retractor posterior muscle, and adjoining the pericardium.

The animals examined are unisexual, the organ being situated around the digestive gland.

Regarding the branchia Dr. Ridewood¹ states that the inner demibranch hangs much lower than the outer, and the ascending lamella of the latter rises considerably above the level of the gill-axis, forming a supra-axial extension. The gill lamellæ have enlarged principal filaments with a grooved frontal border.

The number of filaments in a plica varies from twenty-four to thirty, and are the same in both demibranchs. There is a fairly large blood-tube in the sub-filamentar tissue in the apex of the plica, and all the interlamellar septa, and not the alternate ones only, extend high up the demibranch. The ordinary filaments present no exceptional features. There is a fair amount of muscle-fibre around the interlamellar spaces and in the interlamellar septa.

Nervous System.—The cerebro-pleural ganglia (Fig. 2, *C.P.G.*) are far apart, and situated between the adductor and the anterior retractor muscles, and close to the ventral surface. They are joined by a commissure passing close to the adductor muscle and in front of the œsophagus. Each ganglion sends out anteriorly a nerve which

¹ "On the Structure of the Gills of Lamellibranchia": Phil. Trans., B. cxcv, p. 248, 1903.

innervates the anterior adductor muscle and the fore-part of the mantle-lobe, and continues as the circumpallial nerve, which apparently joins the posterior pallial nerve. The visceroparietal ganglia (Fig. 2, *V.C.P.*) are situated near the antero-ventral edge of the posterior adductor muscle. Each cerebro-visceral connective (Fig. 2, *C.V.C.*) passes outside the pedis retractor anterior muscle alongside the viscera, and between the transverse pedal muscle until near the retractor posterior muscle, when it pierces the pedal integument and then proceeds outside the retractor muscle to the visceroparietal ganglion. Ventrally from each cerebro-pleural ganglion passes the pedal connective (Fig. 2, *C.P.C.*), which goes along the longitudinal and between the transverse muscles of the foot until it reaches the pedal ganglion (Fig. 2, *P.G.*) situated just in front of the digestive gland, but nearly buried in a transverse muscle-bundle. The branchial nerves leave the visceroparietal ganglia on the posterior side, and, curving, run along the base of the gills. Posteriorly from the visceroparietal ganglia run the posterior pallial nerves, which innervate the posterior adductor muscle, the siphon, and the posterior portion of the mantle-lobes. The nerve which innervates each siphonal tube is divided into six branches, each branch running along it to the distal end.

The sense organs, as well as the distribution of the finer nerve branches in the siphon and the mantle-lobes, are fully described by Rawitz in his work *Der Mantelrand der Acephalen*.

PSAMMOBIA FERROENSIS (Chemnitz).

External Characters.—The one animal examined measures 21 by 10 mm. The dorsal surface is somewhat triangular, with a depression on the posterior side. The anterior part is curved, whilst the posterior is quite angular. As in *P. vespertina* the ventral portion of the latter projects backwards. The ventral side is only very slightly curved. Further, the animal is not so deep as *P. vespertina*.

The crescence of the mantle-lobes appears to be the same as in *P. vespertina*, but the proximal portion of the siphon extends a little more anteriorly. The siphonal tubes are long, and in Fig. 8 it will be observed how the central part widens when wholly or partly withdrawn (*Ex.S.*). The anterior adductor muscle (Fig. 8, *A.A.*) is wider than it is deep, and shows a constriction at the centre of the under-surface. Compared with *P. vespertina* it is comparatively a smaller muscle, being shorter and shallower, and at the same time situated in a more oblique position. The posterior adductor muscle (Fig. 8, *P.A.*) is slightly angular at the dorso-anterior edge, and differs from that of *P. vespertina* in being relatively not so deep, but shorter and wider.

Alimentary Canal.—The œsophagus (Figs. 8, 9, and 10, *Oe.*) is moderately long, narrow, and curved. The stomach is divided into several lobes, as in *P. vespertina*, but the œsophageal division (Figs. 9 and 10, *Oe.St.*) is small and triangular in shape. The demarcation of the cardiac division (Fig. 10, *C.St.*) is well defined on the right side, but not on the left. The pyloric division (Figs. 9 and 10, *P.St.*)

is large and opens on the ventral side into the cæcum of the crystalline style (Fig. 9, *C.C.*), the latter being long and curved posteriorly. As in the other species the intestine (Fig. 10, *In.*) appears as a constricted groove on the right side of the cæcum, and does not become complete until it leaves the distal end of the sac, then it continues in a sinuous course (Fig. 8, *In.*) to the posterior part of the stomach, where it turns and passes as the rectum (Fig. 8, *R.*) over the posterior adductor muscle.

Concerning the branchia Dr. Ridewood says: "The plicæ of the outer demibranch have about 14, those of the inner about 18, filaments . . . The principal filament bears a false resemblance to a couple of ordinary filaments, due to the sharply-cut sides of the frontal groove, and to the fact that each of the halves is about the same size as an ordinary filament."

PSAMMOBIA *TELLINELLA*, Lamarck.

External Characters.—The largest animal examined measures 25 mm. by 11 mm. The dorsal surface is very slightly triangular, but the remaining ones are curved, with the ventro-posterior part projecting more posteriorly, the same as in the other species.

The mantle-lobes are thin and possess the usual marginal muscular band, which, like that in *P. vespertina*, tapers towards the rear part of the animal. The mantle-borders have the three characteristic longitudinal folds, and the apposed surfaces of the middle and outer ones are nowhere fused except on the dorsal surface between the adductor muscles, but the inner ones coalesce over the whole of the dorsal surface of the posterior adductor and the greater portion of the anterior adductor. Between the anterior adductor and the musculus cruciformis is the large pedal aperture. Above the latter muscle the inner folds are first united, then they are connected with the external walls of the proximal portion of the siphon as in *P. vespertina*. The middle fold carries a tentacular fringe, and the pallium extends some distance posteriorly to the divergent inner fold, and is capable of quite enclosing the withdrawn siphonal tubes.

Comparatively the siphonal tubes (Fig. 11, *In.S.* and *Ex.S.*) do not appear to be so large or muscular as those of *P. vespertina*, and the proximal part of the siphon is not situated so far anteriorly. The foot is large and muscular, and usually lies in an anterior direction.

The anterior adductor muscle (Fig. 11, *A.A.*), situated on the antero-dorsal side, lies parallel to the edge of the mantle with its ends conforming to the convexity of the shell. There is only a slight indication on the ventro-posterior surface of the constricted part as noticed in *P. vespertina*. The posterior adductor muscle (Fig. 11, *P.A.*), somewhat ovate-shaped, is situated in the dorsal part at the posterior end of the animal, and its ends likewise conform to the convexity of the shell.

A lateral view of the retractor pedis anterior muscle shows it to be wide dorsally, and tapering ventrally, whilst the retractor pedis posterior muscle (Fig. 11, *P.R.P.*) is perhaps shorter and thicker

than in *P. vespertina*. The pedis elevator (Fig. 11, *E.P.*) is more central.

Alimentary Canal.—The lips (Figs. 11, 12, and 13, *A.L.* and *P.L.*) project forwardly. The œsophagus (Figs. 12 and 13, *Oe.*) is long and comparatively narrow. It runs directly backwards to the œsophageal division (Fig. 12, *Oe.St.*) of the stomach, the latter being small and bordered at the rear end by a conspicuous process of the wall of the stomach (Fig. 12, *M.P.*), a continuation of which separates the œsophageal from the cardiac, central, and pyloric divisions. The cardiac division (Fig. 12, *C.St.*) is likewise small, and so is the central division (Fig. 12, *C.D.*). The pyloric division (Figs. 12 and 13, *P.St.*) is very large, and, on its ventral side, opens into the cæcum of the crystalline style (Figs. 12 and 13, *C.C.*). The cæcum is long and extends in a ventral direction. On the right side of it is the intestine, appearing as a narrow groove. At the distal end the intestine becomes free, and passes dorsally until over the pyloric division, where it makes a number of folds, goes posteriorly over the posterior adductor muscle, and terminates in a simple slightly projecting anus on the postero-ventral side of the muscle.

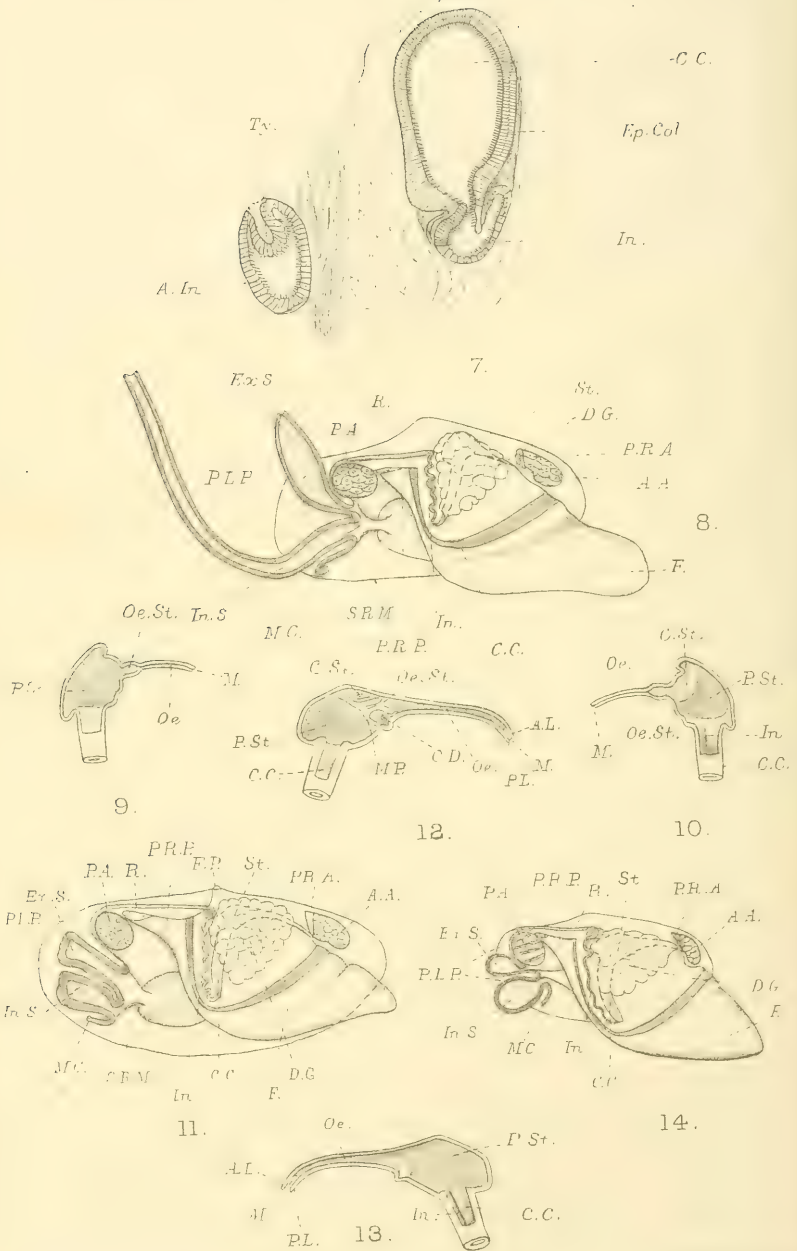
In the branchia the plicæ have in the inner demibranch from 17–21 filaments, and in the outer from 14–17 filaments. The principal filament is very shallow.

PSAMMOBIA COSTULATA, Turton.

Only one animal has been examined, and it measures 14 mm. by 7 mm. The dorsal surface is not quite so curved as in *P. tellinella*, but the ventral part is deeper, otherwise the mantle-lobes in the distribution of the pallial muscles and the characters of the longitudinal folds are similar.

The anterior adductor muscle (Fig. 14, *A.A.*) is like that of *P. tellinella*, with the exception that the postero-ventral part is laterally a little more compressed. The posterior adductor muscle (Fig. 14, *P.A.*), which is situated more posteriorly than in *P. tellinella*, is also similar in shape, but the ends are flatter, as the portion of the shell to which it adheres is not so curved, and further the surface is ribbed, corresponding with the ribbings of the shell.

A. anus; *A.A.* anterior adductor muscle; *A.In.* ascending intestine; *A.L.* anterior or upper lip; *C.C.* cæcum of the crystalline style; *C.D.* central division of the stomach; *C.P.C.* cerebro-pedal connective; *C.P.G.* cerebro-pleural ganglion; *C.St.* cardiac division of the stomach; *C.V.C.* cerebro-visceral connective; *D.G.* digestive gland or liver; *D.M.G.* duct of mucus gland; *E.P.* elevator pedis muscle; *Ep.C.* epithelial cells; *Ep.Col.* columnar epithelium; *Ex.S.* exhalant siphonal tube; *F.* foot; *In.* intestine; *In.S.* inhalant siphonal tube; *M.* mouth; *M.C.* musculus cruciformis; *M.G.* mucus gland; *M.P.* prominent process of the gastric wall; *Oe.* œsophagus; *Oe.St.* œsophageal division of the stomach; *P.A.* posterior adductor muscle; *P.G.* pedal ganglion; *P.L.* posterior or lower lip; *P.L.P.* posterior portion of the mantle-lobe; *P.P.* protractor pedis muscle; *P.R.A.* retractor pedis anterior muscle; *P.R.P.* retractor pedis posterior muscle; *P.St.* pyloric division of the stomach; *R.* rectum; *S.R.M.* siphonal retractor muscle; *St.* stomach; *Ty.* typhlosole; *V.* ventricle; *V.P.G.* viscero-parietal ganglion.



EXPLANATION OF PLATES IX AND X.

PLATE IX.

- FIG. 1. *Psammobia vespertina*, in a partly expanded condition. Nat. size.
 „ 2. *P. vespertina*. View from the right side, showing internal structure, etc. Nat. size.
 „ 3. *P. vespertina*. Longitudinal section of the stomach, showing the internal structure of the left side. $\times 2$.
 „ 4. *P. vespertina*. Longitudinal section of the stomach, showing the internal structure of the right side. $\times 2$.
 „ 5. *P. vespertina*. Transverse section through the super-pallial chamber. $\times 16$.
 „ 6. *P. vespertina*. Mucus glands from the internal part of the pallial lobes bordering the super-pallial chamber. $\times 430$. (Details by Leitz. Oc. No. 1. Obj. one-twelfth oil immersion.)

PLATE X.

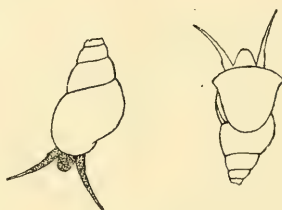
- „ 7. *P. vespertina*. Transverse section through the cæcum of the crystalline style and intestine. $\times 20$.
 „ 8. *P. Ferroensis*. View from the right side, showing internal structure. $\times 2$.
 „ 9. *P. Ferroensis*. Longitudinal section of the stomach, showing the internal structure of the left side. $\times 4$.
 „ 10. *P. Ferroensis*. Longitudinal section of the stomach, showing the internal structure of right side. $\times 4$.
 „ 11. *P. tellinella*. View from the right side, showing internal structure. $\times 2$.
 „ 12. *P. tellinella*. Longitudinal section of the stomach, showing the internal structure of the left side. $\times 4$.
 „ 13. *P. tellinella*. Longitudinal section of the stomach, showing the internal structure of the right side. $\times 4$.
 „ 14. *P. costulata*. View from the right side, showing internal structure. $\times 2$.
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NOTE ON THE ANIMAL OF THE GENUS *CLEOPATRA*.

By E. A. SMITH, I.S.O.

Read 11th November, 1910.

THE animal of this genus does not appear to have been observed, although the radula of *C. bulimoides* is described by Troschel. Mr. H. B. Preston kindly gave me specimens of *C. ferruginea*, Lea, and *C. cingulata*, Martens, which he had received from Shimbi Hills, British East Africa. These, on being placed in tepid water, revived after a period of some months in a dry condition. They appear to be very sluggish in their movements, but this may possibly be due to the unnatural conditions under which they now exist. The animals of both species are very much alike, and in general features resemble that of the genus *Bithynia*.



The proboscis in *C. ferruginea* is rather large, flattish, extensile and contractile, rather blunt at the end, and cleft longitudinally, streaked across with fine black lines. The tentacles, 7–8 mm. in length, are very slender, and acutely pointed, transparent, but speckled with black. No neck-lappets, such as occur in *Vivipara*. The eyes are minute, slightly prominent, and situated on the outer side of the tentacles towards the base. Foot small, broad, widely curved in front, somewhat auriculate anteriorly at the sides, narrower and rounded behind. Above of a semi-transparent smoky appearance, mottled with yellowish specks, uniformly pale beneath.

On removing the animal from its shell the mantle is seen to be of a bright-green tint, excepting the margin, which is yellowish. The liver also is of a similar verdigris-green colour.

In *C. cingulata* the foot is a little more pointed behind, and rather more distinctly streaked with excessively fine black lines. There are yellowish mottlings between the streaks, and towards the margin it is pale and unstreaked.

As only two or three specimens have been observed it cannot be said whether these slight differences are constant or not.

On comparison with a figure of *Bithynia tentaculata* given by Moquin-Tandon, the foot is seen to be rather shorter and more pointedly auriculate in front, and the tentacles are more acutely tapering.

ON THE NAMES USED BY BOLTEN AND DA COSTA FOR GENERA
OF VENERIDÆ.

By A. J. JUKES-BROWNE, F.R.S., F.G.S.

Read 9th December, 1910.

INTRODUCTORY.

I ASSUME that the members of this Society desire to adopt the Rules of the International Commission on Zoological Nomenclature, and to apply them to the fixation of generic names, so that we may at length obtain that great desideratum in Biology, a common international generic nomenclature for all classes of animals.

The rules of the Commission were first separately printed in 1905 at Paris, in three languages (French, English, and German), and are obtainable from F. R. de Rudeval, 4 Rue Antoine Dubois, Paris. The starting-point of our nomenclature is the tenth edition of Linnæus' *Systema Naturæ*, issued in 1758; and under these rules a genus is a group of organisms, bearing the earliest name applied to any of them on or after that date, the application of this name being fixed by the designation or selection of a type-species, which then becomes the genotype.

Rule 30 deals with the designation and selection of types, but the original rule was altered by the Commission in 1907, and the designation of types was made clearer and more definite. Moreover, the following important clause was added: "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type."

It is desirable that all conchologists should fully realize what this last paragraph involves. It is well known that the older authors, including Lamarck and Cuvier, had no idea of basing their genera on single typical species. Their idea of a genus was a group of organisms which had certain characters in common, so that the group could be defined by a description of those characters; and they gave sometimes one species, sometimes two or more, as examples of the generic group.

I am not aware when and by whom the modern idea of a genotype was first introduced; it may have been adopted by botanists before it was used in zoology. In our branch of science it seems to have been recognized about 1840, for the idea is clearly presented by Dr. J. E. Gray in 1847.¹ He, however, took single examples given by Lamarck, Montfort, Megerle von Muhlfeldt, and others as types, without any critical distinction between genera proposed by these authors and genera that were merely restricted by them. In this he has been followed by most subsequent authors, but the new rule clearly introduces such a distinction.

It is clear that, when an author proposes a new genus and cites only one species, this species becomes *de facto* the genotype (Rule 30,

¹ Proc. Zool. Soc., pt. xv, p. 129. A paper entitled "List of the Genera of Recent Mollusca, their Synonyma and Types".

a and *c*); but when an author cites a single example of a previously established genus, even if he restricts that genus by the abstraction of some of its members to form a new genus, his example is not strictly the designation of a type.

This interpretation of Rule 30 will make it necessary to revise the history of certain names, especially some of those in Lamarck's list of 1799, in order to ascertain whether his examples can be accepted as types. In many cases it may be possible and desirable simply to confirm his selection and to secure the continuance of existing nomenclature by definitely designating his examples as types. In some cases, however, this course may not be desirable, but such cases should be very carefully considered before any change is made, for another clause of Rule 30 makes such a change, once effected, unalterable.

Again, the rule of establishing the names which were properly used and published by the earliest author after 1758 has not yet been fully complied with, especially in regard to some of Bolten's and Da Costa's names. With regard to the use of Bolten's names (*Museum Boltenianum*, 1798), I agree with Dr. Dall that if Mörch's names are accepted those of Bolten cannot be disallowed; the two catalogues stand on precisely the same footing, for both give examples of well-known species as examples of their groups.

With respect to Da Costa, one of his names (*Glycimeris*) has been generally adopted with his application of it, but there are two others which must be recognized, for his *British Conchology* was published in 1778, a date which gives it priority over both Bolten and Lamarck.

The names that will be dealt with in the following pages are *Venus*, *Paphia*, *Gafrarium*, *Cytherea*, *Pectunculus*, and *Cuneus*.

VENUS.

The history of this name and its applications is a curious one, for the large group of shells to which Linnæus gave the name included practically the whole family Veneridæ with several other genera which have since been relegated to other families.

The first author to divide the Linnæan genus was Bolten, who distinguished four groups of species under the names of *Paphia*, *Gafrarium*, *Cytherea*, and *Venus*, mentioning certain of each, but not designating types. Bolten's groups are heterogeneous assemblages, for he seems to have classified them by external characters only, such as shape and sculpture; but they have to be recognized, and Dr. Dall has already selected types for *Paphia*, *Gafrarium*, and *Cytherea*,¹ all of which will be discussed in the sequel.

Bolten's *Venus* still remained a large and varied assemblage, but of course it does not follow that the type of *Venus* must be one of the species mentioned under this head by Bolten; it may or might have been chosen from the original assemblage of Linnæus, if that included other species which did not belong to Bolten's other groups, when determined by properly selected types.

¹ Trans. Wagner Free Inst. Sc., vol. iii, pt. iv, 1902.

First, then, it is necessary to ascertain whether any subsequent author has designated a type for *Venus* in accordance with the provisions of Article 30 of the Rules. Dr. Dall, in the publication above referred to, supposed that Lamarck had done so by giving *V. mercenaria* as the sole example of the genus as understood by him in 1799, after the separation of a group with lateral teeth which he then called *Meretrix*. We have seen, however, that the citing of a single example by any author subsequent to its first publication does not constitute the proper selection of a type. Hence Lamarck did not fix the application of the name *Venus* any more than Bolten did.

That Lamarck had no idea of typical species, and no intention in 1799 of citing *V. mercenaria* as other than merely a common exemplar of the genus, is proved by the fact that only two years later he published his *Système des Animaux Invertébrés*, and in that he gave *V. verrucosa* as the sole example of the same genus. Moreover, in the Preface to the *Système* of 1801 he expressly states—"j'ai cité sous chacun d'eux (i.e. des genres) une espèce connue, ou très rarement plusieurs, et j'ai joint quelques synonymes que je puis certifier; cela suffit pour me faire entendre."

Finally, in his *Histoire des Anim. sans Vert.* of 1818, where he gives all the species of *Venus* known to him, he does not mention any typical species, but divides the whole assemblage into two groups—(1) those with crenulated margins, (2) those with smooth margins. The first species of the first group is *V. puerpura*, though, of course, *verrucosa* and *mercenaria* come under the same heading.

Other authors who published schemes of classification about the same time, such as Link (1807), Megerle (1811), Cuvier (1817), and Schumacher (1817), treated the *Venus* of Linnæus in the same way, i.e. they separated certain generic groups and left the remaining species under the head of *Venus*. Even Megerle, who gives *V. dione* as the sole example of his restricted genus, evidently meant it to include the same group of species which Lamarck had already called *Meretrix*, i.e. all the species which were not included in his *Chione*, *Tapes*, *Trigona*, and other genera which he had separated from the *Venus* of Linnæus.

For many years after the publication of Lamarck's *Histoire des Anim. sans Vert.* most conchologists simply accepted the genera founded by him, but in 1838 J. E. Gray published a "Catalogue of the Species of the genus *Cytherea*",¹ subdividing it into sections or subgenera for which he adopted some of the names proposed by the authors above mentioned, and employed a new one of his own (*Dosina*) for the *puerpura* and *verrucosa* group; but he did not then attempt to define the genus *Venus*.

In 1847, however, Gray made an attempt to determine the types of all the genera of Mollusca recognized by him at that date.² This was a praiseworthy endeavour to establish these genera on a proper basis, but unfortunately he was rather arbitrary in his selection of types,

¹ *The Analyst*, vol. viii, p. 302.

² *Proc. Zool. Soc.*, 1847, p. 183.

and he candidly admits the difficulty of designating the type-species in the case of authors "who only give the genera and simply mention one or two examples as the types of their genus".

In this publication he abandons his name *Dosina*, and under the head of *Venus* he cites the example (*V. verrucosa*) given by Lamarck in 1801, instead of that given in 1799, and does not adduce any reason for selecting the one rather than the other. It is clear, however, that he is not himself designating a type, but supposes that he is indicating what Lamarck meant to be his type. At the same time there is no doubt that he thought he had fixed what ought to be known as the genus *Venus*. Hence a few years later we find Deshayes, in a British Museum Catalogue published under Gray's supervision, referring to Gray's group of 1847 as "genus emendatum, rectius circumscriptum".¹ At the present day there is no unanimity about the application of the Linnean name; some following Gray in applying it to the *puerpura* and *verrucosa* group; some, like Fischer (1887) and Dall (1903), preferring Lamarck's earlier example (*V. mercenaria*) as the type.

Thus we arrive at the conclusion that no one has yet properly selected a type for *Venus*; the original Linnean genus has simply been broken up into a number of genera and subgenera, each individual author reserving a genus *Venus* and mentioning one or more species as examples to indicate his conception of it, but without making any definite selection of a type-species.

Consequently it is necessary to review the whole question in order to ascertain what species ought to be regarded as the type of the genus. In doing this I shall try to follow the rules and recommendations of the International Commission as far as possible. In the first place the species chosen must be among those mentioned by Linnaeus. Secondly, Recommendation *k* says: "If some of the original species have later been classified in other genera, preference should be shown to the species still remaining in the original genus." In this case the original genus is what would now be called a family, and all the species have been assigned by different authors to subsequently created genera. It is impossible to proceed by the simple elimination of genera; moreover, Bolten's subdivisions were mere arbitrary assemblages, not distinguishable from one another by any common generic characters; so that Lamarck was really the first to make a reasonable and truly scientific division of the Linnean *Venus*. I think, therefore, everyone will admit that the type of *Venus* should be selected from among the species classed by Lamarck under that name, after the separation of those which possess conspicuous lateral teeth, and after the separation of some Linnean species which belonged to very different genera. At the same time it will be desirable to avoid choosing any species actually mentioned by Bolten under his divisional names of *Paphia*, *Gafrarium*, and *Cytherea*.

Coming, then, to the consideration of the Lamarckian species of *Venus*, we must remember that many more species were known to Lamarck than to Linnaeus, and that none of these are eligible. All

¹ *Catalogue of the Bivalve Shells in the British Museum*, 1853, p. 98.

the Lamarckian species have been included under one or other of the following names, whether these be regarded as genera or subgenera:—

Chione (Megerle, 1811).

Tapes (Megerle, 1811).

Mercenaria (Schumacher, 1817).

Anomalocardia (Schumacher, 1817).

Clausina (Brown, 1827).

Gomphina (Mörch, 1853).

Circomphalus (Mörch, 1853).

Marcia (H. & A. Adams, 1857).

Katelsia (Römer, 1857).

Hemitapes (Römer, 1857).

Presumably the proper procedure in such a case is to displace one of the most recently formed genera by taking its type as the type of *Venus*, provided that the species is otherwise eligible for selection. Now of the species referable to *Marcia*, *Katelsia*, and *Hemitapes*, none were known to Linnæus, neither were the species of *Gomphina*. Again, the type of *Clausina* (*V. verrucosa*) is one of those mentioned by Bolten under *Cytherea*, and *Circomphalus* is only a subgenus of this group, by whatever name it may be known.

Chione and *Tapes* are eliminated as being of earlier date than Schumacher's divisions, and I regard *Anomalocardia* as merely a subgenus of *Chione*, so that if its type were chosen to be that of the genus *Venus* it would elevate a small group to higher rank than a large one. The only remaining group is that of *Mercenaria*, which is based on the *V. mercenaria* (Linn.), a shell mentioned under *Venus* by Bolten, and given by Lamarck as his example of *Venus* in 1799. The selection of this species has the advantage of confirming Dr. Dall's choice which was made before the promulgation of the strict rule by the International Commission. This is a satisfactory conclusion because further alteration is thereby avoided, and Dr. Dall's nomenclature has already been accepted by Australian and New Zealand conchologists.

I am not inclined, however, to follow Dr. Dall in restricting the genus to the small group of shells typified by *V. mercenaria*. I am by no means sure that it is generically distinct from *Chione*, and I am quite unable to understand why Dr. Dall separated the '*Venus*' *Dombeyi* group from his *Venus* and *Chione* groups. He unearthed Molina's name of *Thaca* for *V. Dombeyi*, and made it the type of a new subgenus for which he proposed the name of *Protothaca*; but instead of placing this under *Chione* he classed it under *Tapes* (i.e. *Paphia*).

In reply to inquiry as to its affinities with *Tapes*, the only reason he gave me was that he may have been biassed by the fact that the North American species had usually been called *Tapes*! As these shells have the hinge of *Chione* and *Venus*, a strong radial sculpture which is seldom found in *Tapes*, and crenulated valve-margins, I regard them as very closely allied to the two former groups, and very distinct from the last.

Protothaca only differs from *Venus* in having a strong radial sculpture and in the absence of rugosities on the posterior teeth, but the latter character is not of generic importance, for such rugosities are present in several species of *Chione*. Again, while the typical section of *Chione* has strong radial structure, other sections have only concentric ribs or riblets. If all are regarded as included in the

genus *Venus*, this can be described as having normally a cancellate structure, the radial element sometimes becoming obsolete except along the valve-margins, which are always crenulated.

CYTHEREA (Bolten).

The revival of a name which has been associated for a long time with one group of shells but displaced by an older one, and its subsequent application to another group, is a very irritating consequence of the modern rules of nomenclature. If, however, we are to adhere strictly to the rule of priority and to definition by genotype, such transferences of names must sometimes be the result; and it is so in the case of the name *Cytherea*.

Every conchologist knows that this name was used by Lamarck in 1806 because he repented of having adopted the name *Meretrix* for a certain genus in 1799, but under the law of priority even the author of a genus cannot abandon his earlier name, and consequently *Meretrix* has displaced *Cytherea* for the group of which *Venus meretrix* (Linn.) is the type.

Lamarck, however, was not the first to employ the name *Cytherea*, for, as we have seen, Bolten had given it to one of his divisions of *Venus*. His *Cytherea* was a very heterogeneous assemblage, for the species which he included therein belong to several different genera, and seem to have little in common. His first species is *V. granulata*, Gmel. (a *Chione*), the second is *V. tigrina* (a *Codakia*), two belong to *Circe*, five to *Dosinia*, and the remaining three are *V. puerpura*, *V. rugosa*, and *V. verrucosa*.

In dealing with this assemblage for the purpose of selecting a type, Dr. Dall rightly eliminated the species belonging to genera established by Scopoli, Megerle, and Schumacher, and then remarked that "Schumacher's names reduce *Cytherea* (Bolten) to Veneridæ of the type of *V. puerpura*, for which it must be retained".

This selection by Dr. Dall is unalterable, unless it can be shown that there was an earlier selection of type, as in the case of *Gafrarium*. So far as I can ascertain, no one else has noticed or commented on Bolten's use of *Cytherea* except the Messrs. H. & A. Adams, and they seem to have overlooked it when compiling their arrangement of Veneridæ, for it is only in their Corrigenda at the end of vol. ii, *Genera of Recent Mollusca*, that we find "for *Timoclea*, Leach, read *Cytherea*, Bolten". Clearly they would have taken Bolten's first species as the type of his group, but such a note in the corrigenda of a book is certainly not a proper designation of a type; consequently it counts for nothing.

We have seen that Gray in 1847 chose to regard *Venus verrucosa* as the type of *Venus*, because Lamarck had given that species as an example in 1801; but that Lamarck's examples were not intended to be taken as types, and that Gray cannot be said to have made a selection from the whole group *Venus* of Lamarck. Hence I regard Dr. Dall's selection of *V. puerpura* as the type of Bolten's *Cytherea* as a valid designation.

The genus *Cytherea* (Bolten) will include the following sections:—

Cytherea (s.s.), with type *V. puerpura*, Linn.

Section 1. *Clausina* (Brown); type, *V. verrucosa*, Linn.

Section 2. *Ventricola* (Römer); type, *V. rugosa*, Gmel.

Subgenus *Artena* (Conrad); type, *Venus staminea*, Conrad, 1842.

(= *Antigona*, Schumacher, non *Antigonus*, Hubner, 1816.)

Subgenus *Circomphalus* (Mörch); type, *V. plicata*, Gmel.

GAFRARIUM.

The assignation of this name requires discussion, because it appears to have been fixed by Messrs. H. and A. Adams in 1857, and if this is so Dr. Dall's more recent selection of a different type cannot be allowed.

As already mentioned, the name was employed by Bolten for one of his divisions of the Linnean *Venus*, but he only included three species under it, and these only agree in having a strong cancellate structure. Moreover, they possess no character by which they can be distinguished as a group from his next division, which he called *Cytherea*. It happens, however, that the first species is *Venus fimbriata* (Gmel.), which Cuvier afterwards called *Corbis*; the second is *V. pectinata* (Gmel.) and varieties; the third is *V. reticulata* (Gmel.).

When Dr. Dall was dealing with Bolten's divisions of *Venus* in 1902, he seems to have thought that he was at liberty to make his own choice of a type for each and all of them, and acting in the spirit of the Recommendations of the International Commission he sought to displace the latest formed generic name. Thus, of *Gafrarium* he wrote: "*Gafrarium* (Bolten) is by this time [1817] relieved of the genus *Corbis*, and retains only *V. reticulata* and the *Circes* of the group later called *Crista* by Römer. *V. reticulata* belongs to *Cytherea* (Bolten)." These last words mean that by his selection of *V. puerpura* as the type of Bolten's *Cytherea*, *V. reticulata* belongs to that genus. Thus he is led to make *V. pectinata* the type of *Gafrarium*, which consequently in his scheme becomes a genus, with the *Circe* of Schumacher as a subgenus (type *C. litterata*).

This selection would be perfectly correct and unalterable if no previous selection of a type had been made. Dr. Dall, however, appears to have overlooked the fact that Messrs. H. and A. Adams¹ definitely adopted Bolten's name *Gafrarium* as a genus in the place of *Corbis*, giving *V. fimbriata* as their figured example. It is true that they did not definitely designate this species as the type of the genus, and that they recognized four other species of *Gafrarium* (or *Corbis*), but these so-called species are now admitted to be merely varieties of *V. fimbriata*, and Dr. Dall himself, writing of the genus *Corbis* in his "Synopsis of the Lucinacea",² says: "The type and sole recent species is *Venus fimbriata*, Linn."

Hence the genus, by whatever name it is called, is monotypical, and the Messrs. Adams applied Bolten's name *Gafrarium* to a species

¹ *Genera of Recent Mollusca*, vol. ii, p. 470, 1857.

² *Proc. U.S. Nat. Museum*, 1901, p. 816.

which is a monotype, and must therefore be a genotype. It seems to me, therefore, that they really made a definite selection of a type for the genus *Gafrarium*, and that their application of the name should be accepted in preference to that of Dr. Dall. In other words the name *Gafrarium* should take the place of *Corbis*, and *Circe* should remain as a genus of Veneridæ, with *Crista* (Römer) as a subgenus.

PAPHIA (Bolten).

Paphia is a name which has unfortunately been applied to very different shell-groups by different writers, but we are bound to go back to the author who first used the name in binomial nomenclature, and to select a type from the species of his group. The first author in this case is Bolten, and his *Paphia* only included six species, namely, *Venus ala-avis*, better known as *V. gigantea*, Gmel., *V. Meroe* (a *Sunetta*), and four species of *Tapes*. Now *Sunetta* was established as a separate genus by Link in 1807, and *Tapes* by Megerle in 1811, while *Venus gigantea* was not separated from *Meretrix* and *Callista* till 1876 (as *Macrocallista*, Meek). It is therefore Meek's name which should have given place to Bolten's, and *Paphia* should have replaced *Macrocallista*.

Unfortunately, when Dr. Dall adopted Bolten's names for genera of Veneridæ he did not do this. His discussion of the matter is brief and incorrect, for he wrote: "From *Paphia*, Bolten, *Sunetta* and *Meretrix* have been eliminated, leaving only species of the genus ordinarily called *Tapes*, which must retain Bolten's name."¹ It is clear that he intended to choose the type by elimination, and that the mention of *Meretrix* is a mistake, for on p. 1220 he had properly referred *V. gigantea* to *Macrocallista*, which was proposed by Meek as a subgenus of *Callista* (Poli), not of *Meretrix* as restricted by Dall himself and typified by the *V. meretrix*, Linn. He should have eliminated the species of *Tapes*, and have attached the name *Paphia* to *V. ala-avis*. This application of the name would have been a satisfactory solution of the *Callista* difficulty, whereas the displacement of *Tapes* is very inconvenient and irritating, on account of its having been constantly used in conchological nomenclature for sixty or seventy years. It is a question, however, whether anyone is at liberty to correct Dr. Dall's mistake, for it does not contravene any of the existing rules of the International Commission, only one of the recommendations, and Article 30g says: "Any subsequent author may select the type, and such selection is not subject to change."

On the other hand, the selection made in this case is not in accord with the principle of priority, for it leads to the displacement of a generic name which has priority over another available name. This is a result which ought not to be allowed by the Rules of Nomenclature, i.e., it should not be possible for Megerle to be deprived of his right to the perpetuation of the genus *Tapes*, if a later generic creation can be displaced in its stead.

Consequently I think that the direction to select a type by the

¹ Trans. Wagner Free Inst. Sc., vol. iii, pt. vi, p. 1222, 1903.

elimination of species in order of their separation from the original genus should be made a rule, and not merely a 'recommendation'. I hold that *V. ala-avis* is the only proper type of Bolten's *Paphia*, and that the name *Tapes* has been wrongly displaced by Dr. Dall.

PECTUNCULUS, Da Costa.

The name *Pectunculus* is one of the oldest names which have been applied to shells, and the most ancient use of it (by Lister in 1685) was for the *Chama glycimeris* of Belon, which was called *Arca glycimeris* by Linnæus and *Pectunculus pilosus* by Lamarck in 1799. The general adoption of the Lamarckian nomenclature secured a long continuance for the application of the name to the *Arca glycimeris* group, but when a more strict observance of priority came into vogue the name *Axinaea* (Poli, 1777) was used by some for this group. Eventually, however, Dr. Dall, rejecting Poli's names, pointed out that Da Costa had described this group in 1778 under the name of *Glycimeris*, which consequently should take the place of Lamarck's *Pectunculus*.

Unfortunately Da Costa had also used the name *Pectunculus*, employing it for a number of British shells which Linnæus has placed in his *Venus* group. I do not see how the recognition of Da Costa's *Pectunculus* can be avoided, for the nomenclature in his *British Conchology* of 1778 is unquestionably binomial; he clearly defines his genus, and then describes the species which he assigns to it, and some one of these species must be chosen as the type of his genus.

Everyone, however, seems to have shrunk from reviving the name *Pectunculus*; even Dr. Dall¹ only remarks that this assemblage of Da Costa's "is practically synonymous with *Venus*", and thus dismisses it from further consideration. But the name cannot be rejected for such a reason. Under the rules of the International Commission it must be recognized as a generic name because Da Costa was a binomial author and his use of the name has priority. The facts that it contained a mixture of modern genera and that it had been subsequently applied to another group of shells do not invalidate it. Having adopted the *Glycimeris* of Da Costa as a valid name, Dr. Dall ought certainly to have adopted his other genera *Pectunculus* and *Cuneus* when he was dealing with the nomenclature of the Veneridæ. As he did not do so, I think these names should be established by the selection of types as soon as possible.

There can be little doubt that for some reason or other Da Costa was prejudiced against Linnæus and his nomenclature, and that he thought himself quite at liberty to alter this nomenclature, either by using current names with a different application or by inventing new names. He also felt no obligation to adopt even the specific names used by Linnæus, so that we find him proposing new names for all the species which he refers to his genus *Pectunculus*. The following is a list of

¹ Trans. Wagner Free Inst. Sc., *supra cit.*

these species, together with their Linnean equivalents, and the genera to which they have subsequently been referred:—

SPECIFIC NAMES.

Da Costa's.	Linnean.	MODERN GENERA.
1. <i>P. crassus</i> .	= <i>V. islandica</i> .	<i>Cyprina</i> , Lam., 1812.
2. <i>P. glaber</i> .	= <i>V. chione</i> .	<i>Callista</i> , Mörch, 1853.
3. <i>P. strigatus</i> .	= <i>V. verrucosa</i> .	<i>Cytherea</i> , Bolten (Dall).
4. <i>P. capillaceus</i> .	= <i>V. exoleta</i> .	<i>Dosinia</i> , Scopoli, 1777.
5. <i>P. fasciatus</i> .		<i>Chione</i> , Megerle, 1811.
6. <i>P. vetula</i> .	? <i>V. paphia</i> .	<i>Chione</i> , Megerle.
7. <i>P. striatulus</i> .	<i>V. gallina</i> .	<i>Chione</i> , Megerle.
8. <i>P. sulcatus</i> .		<i>Astarte</i> , Sow., 1816.
9. <i>P. membranaceus</i> .	<i>V. casina</i> .	<i>Circomphalus</i> , Mörch.
10. <i>P. depressior</i> .	= <i>V. crassa</i> (Gmel.).	<i>Tellina</i> (<i>Arcopagia</i>).
11. <i>P. truncatus</i> .		? <i>Tellina</i> (not figured).

Out of these eleven species one has to be chosen as the type of the genus *Pectunculus* (Da Costa), and the next question is to consider what principle should guide us in the selection.

I think this is a case in which we should seek a way of effecting the least disturbance of current nomenclature, and in which one of the least important of the groups represented should bear the name because in the first place the author could and ought to have used the Linnean name *Venus* for his genus, and secondly because it is only the rigid application of modern rules of nomenclature which makes it necessary to revive the name *Pectunculus* at all. It would have been much more satisfactory if the name, once displaced, could have been abandoned for ever; and I think everyone will admit that the application of the name to some other large genus, which has hitherto been known by a different name, would be very irritating and inconvenient.

Since, however, we have to recognize the name *Pectunculus*, let us make choice of a species which will represent a section or subgenus of a previously established genus, i.e. either *Venus exoleta* of Linnæus or the *V. crassa* of Gmelin. The first of these would make *Pectunculus* replace the *Orbiculus* of Megerle, which is a section of *Dosinia* (Scopoli); if the second were chosen it would become a subgenus of *Tellina* in the place of *Arcopagia* (Leach, 1827). On the whole I prefer to select *P. capillaceus* of Da Costa as the type, and to relegate the name *Pectunculus* to a mere section of *Dosinia*, so that its use may trouble no one except those who make a special study of that genus and its subdivisions.

CUNEUS (Da Costa).

This is another name which has been used for different genera or subgenera by different authors, and the proper application of which has never yet been determined.

The earliest post-Linnean and binomial use of it was by Da Costa in 1778, who defined a genus *Cuneus* and assigned to it five British species. Of these two belong to the *Tapes* of Megerle (*T. decussatus*, Linn., and *T. rhomboides*, Penn.), one to *Venerupis*, and two to *Donax*. Under existing rules one of these species must be chosen to perpetuate

the name of *Cuneus*, and we have in the first place to ascertain whether any such selection has been made.

In 1811 Megerle von Muhlfeldt proposed a genus *Cuneus*, but it had no connexion with that of Da Costa, his type being *Venus Meroe*, Linn., which is referable to the genus *Sunetta* of Link (1807), so that Megerle's *Cuneus* has no standing.

In 1851 Gray (List of British Mollusca, p. 46) very properly tried to restrict the name to part of Da Costa's heterogeneous group, but unfortunately he chose *Donax vittatus* as type, which belongs to the *denticulatus* section of *Donax*, separated by Scopoli in 1777 under the name of *Chion* with *D. denticulatus* as example. Gray's selection is therefore invalid, and the name of *Cuneus* must be transferred to some other of Da Costa's species.

On the other hand, in 1853, Mörch adopted the name *Cuneus* (Da Costa) for a group of *Tapes* which included *pullastra*, *decussatus*, *rhomboides*, and others, a heterogeneous assemblage of which no type was indicated.

In 1857 the Messrs. Adams, who always followed the practice of regarding the first species of an author as his type, assigned the name of *Cuneus* (Da Costa) to a restricted group of *Tapes* in which they included his first species, *V. decussatus*. It is evident that they considered this to be his type, though they did not definitely designate it as such, merely giving his generic name to the group.

The only other author to whom we need refer is Dr. Dall, who had the opportunity in 1900 to 1903 of settling the matter and of establishing the genus *Cuneus*, but most unaccountably he avoided doing so. In his "Tertiary Fauna of Florida",¹ under the head of *Donax*, after remarking that the *Donax* of Linnæus was a heterogeneous group he wrote: "Da Costa's *Cuneus* was a similar assembly, a substitution rather than a dismemberment of the Linnæan group, and may be regarded as a strict synonym of *Donax*." This statement is not only incorrect, but, even if it were true, Da Costa's name would still have to be used for some part of this "heterogeneous assembly".

In the continuation of his monograph under Veneridæ, Dr. Dall made the unfortunate mistake already referred to of assigning the name *Paphia* to the *Tapes* group, and under the heading of *Paphia* (p. 1322) he has this curious reference in the synonymy: "*Cuneus*, da Costa, Brit. Conch., p. 202, 1778, not of da Costa, Elem. Conch., 1776 (*Trigonia*), nor *Cuneus*, Deshayes, 1853."

From this one would suppose that he rejected *Cuneus* (Da Costa, 1778), because that of Da Costa, 1776, was different. But Dr. Dall knew very well that Da Costa was not binomial in his first book, and consequently there was no occasion even to mention it. Further, if he admitted that *Cuneus* (Da Costa, 1778) was synonymous with *Paphia* (Bolten), then the former has priority as the generic name.

Thus, I am left to consider the question of choosing a type to perpetuate the name of *Cuneus*, and am faced with a curious difficulty

¹ Trans. Wagner Free Inst. Sc., vol. iii, p. 965, 1900.

in consequence of the mistake made by Dr. Dall with regard to the proper type of *Paphia* (Bolten).

The selection should be made by the elimination of species according to the date of the genera to which they belong. If Dr. Dall's application of the name *Paphia* were allowed to stand, the relative ages of the genera concerned would be in the following order: *Donax* (Linnæus, 1758), *Paphia* (Bolten, 1798), *Venerupis* (Lamarck, 1799). If, however, the *Paphia* of Bolten was wrongly determined by Dall, and should not be applied to the *Tapes* group, then the order of the genera concerned would be *Donax* (Linn.), *Venerupis* (Lam.), and *Tapes* (Megerle, 1811), with the result that *Tapes* would be replaced by *Cuneus*.

Under these circumstances it seems best not to make any definite selection of a type for *Cuneus* until the doubt about the proper choice of a type for *Paphia* has been decided. Meantime it is clear that the rules of the Commission do not yet afford sufficient guidance for the proper selection of types, and that it is premature to enact that any selection should be absolutely unalterable. There should, at least, be the possibility of an appeal to the Commission itself.

Postscript. Since the above was written Dr. Hoyle has announced that a proposal has been submitted to the International Commission on Zoological Nomenclature that a certain number of commonly used generic names should be excepted from the application of the Law of Priority, and that an Official List of these names should be published. Such a plan would solve many difficulties, and should have the approval of a majority of the members of our Society, as it has of the Zoological Society. It appears to be the only legitimate way in which Conchologists can avoid having a large number of the familiar Lamarckian names displaced by the unfamiliar and often uncouth names of Bolten. It will solve all the difficulties raised in this paper if it be simply enacted that the genera *Corbis* and *Pectunculus* of Lamarck and *Tapes* of Megerle are exempted from change; and if *Callista* (Mörch after Poli), with *C. chione* as type, finds a place in the official list there need be no more trouble about the proper type of *Paphia* or about the prior claim of *Callista* (Leach).

ON SOME MISAPPLIED MOLLUSCAN GENERIC NAMES.

By TOM IREDALE.

Read 9th December, 1910.

WHILST engaged upon the determination of Kermadec Marine Molluscs I noted some generic names which seemed to require investigation. The results of my researches I give herewith.

OMALAXIS.

Omalaxis was introduced by Deshayes (Ency. Méthod. Vers., vol. iii, p. 659, 1832) for two Eocene fossils: the first was *Solarium disjunctum*, Lamarck (Annals du Mus. Paris, vol. iv, p. 55, No. 8, 1804); the second, called *Omalaxis bifrons*, was unaccompanied by any note of its prior appearance in literature. In the Coq. Fossil. Paris, vol. ii, p. 221, the following year, Deshayes changed the name of his genus to *Bifrontia*. When so doing he mixed up his references, and has thereby misled all subsequent writers. After translating into Latin the diagnosis of *Omalaxis* he had previously given, he definitely stated "Ce genre est composé du *Solarium disjunctum* et des autres coquilles . . ." He then placed *Bifrontia bifrons* (founded on *Solarium bifrons*, Lamarck, loc. cit., No. 9, 1804) as his first species, and in its synonymy named *Omalaxis disjunctus* of the Ency. Méthod. That this was purely an error can be easily ascertained by making comparisons of the diagnoses given for each species. This action has, however, caused the citation of *Solarium bifrons*, Lam., as the type of *Omalaxis*. As this shell differs conchologically from *Solarium disjunctum*, Lam., it is important that the correct shell be quoted as type. From an examination of these Eocene fossils I believe these are subgenerically separable, and it would have been gratifying to have been able to preserve *Bifrontia* for the 'bifronted' species, but the sentence above quoted forbids this. To those who have not access to specimens of these fossils I recommend a study of the *Iconographie complète Coq. foss. Env. Paris*, by Cossmann and Pissarro. In the second volume (1909), on pls. xvi and xvii, are given figures of ten species of *Homalaxis*, which show clearly the peculiar characters of this group. A fair representation of *Solarium bifrons*, Lam., is shown by figs. 106-11, pl. xvi, whilst the type of *Omalaxis*, *Solarium disjunctum*, Lam., is well figured on pl. xvii, figs. 106-10.

A Sicilian fossil was described by Philippi (Enum. Moll. Sicil., vol. ii, p. 225, pl. xxviii, fig. 11, 1844) as *Bifrontia* (?) *zanclæa*. A recent shell dredged off Madeira by MacAndrew was recorded by Gray (Ann. Mag. Nat. Hist., vol. xi, p. 260, 1853) as identical with Philippi's fossil. Gray pointed out that in the recent shell the last whorl was uncoiled as in the fossils from Paris, and concluded that Philippi's generic location was correct; the live shells gave the opercular characters, which were 'Torinioid'. No other details, as of sculpture or measurements, were adduced. Hanley described and figured the

recent shell (Thes. Conch., vol. iii, p. 246, pl. 254 (v); figs. 101-3, 1863) as *Bifrontia zancleæ*, Phil., and noted that it differed slightly from the fossil as known to him by literature only. Hanley gave no measurements, but alongside the figures was placed a line denoting natural size. It is easily seen from a criticism of the figures that Hanley and Philippi were dealing with different shells. Yet it would appear that no one has ever taken the trouble to compare the recent and fossil shells. First, Philippi's figures are of a shell which does not uncoil, though measuring 11 mm. Hanley's shell, of which the last whorl is uncoiled, measures 4 mm. only. I have examined four fossils which agree well with Philippi's description and figure, and which I consider to be typical; three of them measured 10 mm., the fourth 8.5 mm. in diameter. None of them shows any sign of uncoiling; there are two keels close together above the periphery, both crenulated; there is a fine sculpture of radial growth-lines and concentric threads. I have seen MacAndrew's shells upon which Gray's note was written. Probably they served for Hanley's description and figures. The type tablet contains four shells, the largest under 5 mm. in diameter, and in all the last whorl is unrolled; above the periphery there is only one crenulated keel, and no secondary sculpture. It is necessary that these shells should have a name, and therefore for the recent shell described and figured by Hanley as *Bifrontia zancleæ*, Philippi, I propose the new specific name of *Macandrewi*, and indicate as types the shells in the British Museum dredged by MacAndrew off Madeira.

In the Manuel de Conch., p. 714, 1885, Fischer proposed *Pseudomalaxis* as a subgenus of *Torinia*. He defined it thus: "Coquille discoïde, enroulée, planorbiforme, à tours quadrangulaires; opercule convexe, obtusément conique, saillant. Distribution, Méditerranée, Madère (*P. Zancleæ*, Philippi)." I contend this refers to the shell I have just named *Macandrewi*, and that the type of *Pseudomalaxis* must be *P. Macandrewi*, Iredale.

Fischer (loc. cit., p. 715) used *Homalaxis* for the Eocene fossils, of which the opercular characters are unknown. He queried the identity of *Pseudomalaxis* with the prior *Ilaira* of H. & A. Adams, but the latter has no relationship, as I shall presently show.

Verrill described *Omalaxis nobilis* (Trans. Conn. Acad., vol. vi, p. 423, pl. xlv, fig. 12, 1885) from American waters, and showed the operculum of the American shell to be Trochoid, not 'Torinioid'. In the Bull. Mus. Comp. Zool. Harv., vol. xviii, p. 276, 1889, when Dall recorded this species he gave a history of the attempts to improve the orthography of the name, and then wrote: "*Omalaxis* is divided by Dr. Fischer. *O. zancleæ*, Phil., which has a *Torinia*-like operculum, is placed under *Torinia* with the name of *Pseudomalaxis* (possibly identical with *Ilaira*, H. and A. Adams), while the original name is kept for those having a simple thin operculum of many whorls." As shown above this last statement is inaccurate.

Later, dealing with the Tertiary Mollusca of Florida (Wagner Free Inst. Sci., vol. iii, p. 331, 1892), Dall again approached the matter.

Accepting *Solarium bifrons* as the type of *Omalaxis*, he noted it differed conchologically from Lea's *Orbis rotella* and Verrill's *Omalaxis nobilis*, whilst these agreed in shell characters with Fischer's '*zanclea*', but the opercular characters of the two latter were known to be different. Arguing that the American fossil and recent forms might be allied, and that the European fossil and recent forms went together, he suggested a new name *Discosolis* for the American forms, indicating Verrill's *O. nobilis* as type, and subordinated this to Dunker's genus *Discohelix*, introduced for a European Lias fossil. It appeared from the statement that Dall advised the rejection of *Omalaxis* for shells like *O. nobilis*, Verrill, yet in 1900 Dall and Simpson, writing on the Mollusca of Porto Rico (Bull. Fish. Comm., 1900, p. 432, pl. liv, fig. 12), described *Omalaxis exquisita*, a species conchologically comparable with *O. nobilis*, Verrill.

Sacco (I Mollus. Terr. Terz. Piemonte, pt. xii, p. 75, 1892) used generically *Discohelix* and subgenerically *Pseudomalaxis* for fossils agreeing closely with the true *B. ? zanclea*, Philippi, whilst in the Iconographia, Cossmann and Pissarro, *Discohelix* is used for a shell apparently like the true *B. ? zanclea*, Philippi, and another fossil is referred to the subgenus *Pseudomalaxis* of *Discohelix*. This usage is, of course, due to the confusion of the recent with the fossil shell; a geological student being conversant with the latter and regarding it as the type of *Pseudomalaxis*, whilst, as I have pointed out, the recent shell, now called *P. Macandrewi*, Iredale, must be considered the type, and the genus restricted to shells agreeing in character with that species. Before epitomizing my conclusions I wish to make a few remarks about some shells described as *Bifrontia* or *Omalaxis*.

When Dall introduced *Discosolis* he described a new species as *Discohelix (Discosolis) retifera* (loc. cit., p. 332, pl. xix, figs. 1b, c, 1892). I can see no characters separating that species from *Helicaculus*. Harris (Cat. Tert. Moll. Brit. Mus., vol. i, p. 245) has pointed out that *Torinia*, Gray, was a nude name until after *Helicaculus* had been properly introduced by D'Orbigny (Ramon de la Sagra, Nat. Hist. d'Île de Cuba, vol. i, p. 68, 1842); and two flattened species, *H. discoideus*, Pease, and *H. celatus*, Hinds, show juveniles agreeing with *D. retifera*, Dall, in every conchological character. A very similar shell has been described by Melvill as *Solarium (Torinia) omalaxis*.

Melvill and Standen (Ann. Mag. Nat. Hist., vol. xii, pp. 298, 299, 1903) introduced two new species of *Homalaxis*, as *cornu-ammonis* and *rotula-catherina*, and wrote: "We cannot exactly follow the reasons which prompt Dr. Fischer (Manuel de Conch., p. 714) to propose a subgenus *Pseudomalaxis* for *H. zanclea*, Phil., and consider all the true *Homalaxis*, Desh., tertiary fossils. In our opinion both the species now described belong to the typical genus, and it would be impossible to disassociate *H. Pernambucensis* (Wats.), described as a *Bifrontia* from them." I believe that this statement is based upon an examination of the recent '*zanclea*', as at that time *Solarium bifrons*, Lam., was considered the type of *Omalaxis*, and this shell is very unlike the new species above named. I should place these two

with *P. Macandrewi*, Iredale, as they agree well in conchological characters, though it may be that they will be found to differ when their opercula are obtained. Murdoch and Suter's *Omalaxis amœna* (Trans. New Zeal. Inst., vol. xxxviii, p. 293, pl. xxiv, figs. 30-2, 1905 (1906)), which, when described, was compared with Dall's *D. retifera*, is certainly also a species of *Heliacus*.

However, Hedley (Memoirs Aust. Mus., vol. iv, p. 351, fig. 74, 1903) proposed a new species, *Omalaxis meridionalis*, which seems to agree quite closely with the fossil *Bifrontia*(?) *zanclæa*, Philippi, and this is of much interest, as Tate has often remarked upon the survival of European Eocene in Australian forms, e.g. Trans. Roy. Soc. South Aust., vol. xxiii, p. 243, when referring a *Rissoina* to a Parisian Eocene group. Hedley's *Omalaxis radiata* (Proc. Linn. Soc. N.S.W., vol. xxxii, p. 506, pl. xx, figs. 53-5, 1907) looks like a *Pseudomalaxis*. Watson's *B. Pernambucensis* (Chall. Zool. Rep., vol. xv, p. 137, pl. viii, figs. 1-3, 1885), as Hedley has pointed out (Rec. Aust. Mus., vol. vi, p. 357, 1907), would be better placed elsewhere, though I doubt whether *Liotia* is a suitable genus, as shown hereafter.

Before leaving this subject it may be of interest to note the effect of the presence of the 'anastrophic' apex in the determination of the relationship of these shells. This term was introduced by Dautzenberg and Fischer (Mém. Soc. Zool. France, vol. ix, p. 57, 1896) for the inverted pseudosinistral apex observed in shells belonging to the genus *Solarium*. It is characteristic of shells belonging to the genera *Architectonica* (= *Solarium*) and *Heliacus*, and of all the shells previously referred to *Omalaxis* and *Bifrontia*, save *B. Pernambucensis*, Watson. Consequently I advocate the transference of this shell from the neighbourhood of these Omalaxoid shells.

I would summarize the results I obtain as follows:—

Omalaxis, Deshayes, Ency. Méthod. Vers., vol. iii, p. 659, 1832. Type: *Solarium disjunctum*, Lam. (Ann. Mus. Paris, vol. iv, p. 55, 1804). Should be restricted to fossil forms agreeing with the type, and eliminated for the present from the study of recent conchology. *Bifrontia*, Deshayes (Coq. Foss. Paris, vol. ii, p. 221, 1833) is an absolute synonym, having the same shell as type.

Bifrontia zanclæa, Gray, Ann. Mag. Nat. Hist., vol. xi, p. 260, 1853; Hanley, Thes. Conch., vol. iii, p. 246, pl. 254 (v), figs. 101-3, 1863. Is specially distinct from *Bifrontia*(?) *zanclæa*, Phil. (Enum. Moll. Sicil., vol. ii, p. 225, pl. xxviii, fig. 11, 1844), and should bear the name *Pseudomalaxis Macandrewi*, Iredale.

Pseudomalaxis, Fischer (Man. de Conch., 1885, p. 714). Was introduced for the recent shell confused with Philippi's fossil, and therefore the type is *P. Macandrewi*, Iredale. I do not consider it should be used for the fossil forms agreeing with the true *Bifrontia*(?) *zanclæa*, Philippi. Probable members of this genus are the shells described as *Homalaxis cornu-ammonis*, Melvill & Standen, *H. rotulacatherina*, Melvill & Standen, and *Omalaxis radiata*, Hedley.

Discohelix, Dunker, *Palæontographica*, vol. i, p. 132, 1847. Type: *D. calculiformis*, pl. xviii, fig. 11. Might be used for *Bifrontia*(?) *zanclæa*, Philippi, and here, tentatively, may be referred *Omalaxis*

meridionalis, Hedley, though perhaps the wiser course would be the introduction of a new genus or subgenus for these latter.

Discosolis, Dall, Trans. Wagner Free Inst. Sci., vol. iii, p. 331, 1892. Type: *Omalexis nobilis*, Verrill, Trans. Conn. Acad., vol. vi, p. 423, pl. xlv, fig. 12, 1885. May be used for the American shells with Trochoid opercula; and *O. exquisita*, Dall & Simpson, may be here located until the opercular characters are known.

Discohelix (*Discosolis*) *retifera*, Dall. Should be transferred to *Heliculus*, as also should *Omalexis amœna*, Murdoch & Suter.

Bifrontia Pernambucensis, Watson. Does not belong to this group at all, but I am unable to definitely locate it in any known genus.

TRACHYSMA.

This genus was introduced by Sars (Moll. Reg. Arct. Norv., p. 211, 1878) as of Jeffreys MSS. for a minute shell identified by Jeffreys as *Cyclostoma delicatum*, Phil., and, according to Jeffreys, identical with '*Archithœa catenularia*, Costa'. Apparently Sars was sceptical as to this last conjunction, else why did he not use '*Archithœa*'? The facts are: Philippi described a Sicilian fossil as *Cyclostoma* (?) *delicatum* (Enum. Moll. Sicil., vol. ii, p. 222, pl. xxviii, fig. 3, 1844); its dimensions are given as "Testa $5\frac{1}{3}$ ''' alta, $5\frac{2}{3}$ ''' lata". Costa proposed his genus *Architea* (Annuario Mus. Zool. Napol., vol. v, p. 52, 1869), with the new species *catenulata*, p. 53, pl. i, fig. 4. The beautiful figures there given indicate a shell quite distinct from Philippi's fossil; the size is 13×9 mm., and its multispiral operculum is 6 mm. in diameter. The shell Sars described, upon Jeffreys' advice, as *Trachysma delicatum*, Phil., measured 1.1×1 mm., with a variety *expansa* 1.4×1.2 mm. That these three shells are identical seems an absurd proposition, whilst I have not the least doubt that they are generically distinct. Poppe (Abh. Ver. Brem., vol. viii, p. 364, 1883) records that *Trachysma delicatum*, Phil., was found alive in the inlet of the Jade, North-West Germany, and that the dentition was Tænioglossate. It is difficult to say what Poppe handled, but it may have been Sars' shell. Fischer (Man. de Conch., p. 714, 1885) correctly retained *Architea*, which he wrote *Archytœa*, indicating its probable relationship with *Solarium*. He doubtfully included *Trachysma* in the family Adeorbidiæ, classing Philippi's fossil and Sars' recent shell together, and wrote, "Cette petite coquille classée, par O. Sars, dans le voisinage des *Adeorbis*, a été successivement considérée comme *Cyclostoma*, *Janthina*, *Architea*." I have been unable to trace the fossil *Cyclostoma* (?) *delicatum*, Philippi, in recent geological literature, so am unable to give late opinions as to its generic location, but I feel certain it will not be placed in Sars' genus *Trachysma*, the type of which should not be cited as *delicatum*, Philippi, whatever else it may be called.

LIOTIA.

Liotia has been quoted as of Gray (Syn. Brit. Mus., 1840 and 1842), but in these places only the nude name occurs, with no indication as to species. In the Proc. Zool. Soc. Lond., 1847, p. 145, there appears

"136. *Liotia*, Gray, Syn., 1840. *Delphinula*, sp. Gray, Sow. *Del. cancellata*, Gray". Thus definitely it is stated that the type of *Liotia* is the shell described as *Delphinula cancellata*, Gray. That species was introduced in the Spic. Zool., 1828, p. 3, from Arica, Peru, and there the operculum is described as horny.

In the Fig. Mollusc. Anim., vol. iv, p. 88, 1850, Gray provided a family Liotiadæ, with the diagnosis "Operculum horny, with an external calcareous coat formed of numerous separate pearl-like shelly particles placed in spiral lines". The first genus is—"Liotia, n. 136. Shell variced; lips thick. 1. *L. granulosa*, *Delphinula g.*, Dunker. 2. *L. Krausii*, *Solarium cancellatum*, Kr. 3. *L. cancellata*, *Delph. c.*, Gray=*D. Cobiensis*."

This is of much interest for two reasons: first, Gray's type has taken third place; second, none of the three species quoted agrees with the generic diagnosis given, and only of the last was the operculum known, so that their reference to the family was quite doubtful. Dunker's *Delphinula granulosa* has been identified with *C. granulata*, A. Ad., for which H. and A. Adams introduced *Cynisca* (Gen. Rec. Moll., vol. i, p. 406, 1854), and I believe the opercular characters are yet unknown, whilst the shell is not variced. Krauss' *Solarium cancellatum*, known to me only by figures, appears to be a thin unvariced shell of which the operculum is unknown. Tryon transferred it to *Homalogyra*, but it requires some other resting-place. As pointed out above, Gray's own *cancellata* has a horny operculum, and the shell is not variced, whilst of its lips he wrote "peristomate orbiculari completo, margine tenui". H. and A. Adams (Gen. Rec. Moll., vol. i, p. 403, 1854) reduced Gray's family to sub-family rank under Trochidæ. They gave as examples *L. Peronii*, Kiener, animal and operculum, and *L. scalarioides*, Reeve. These species agreed with Gray's 1850 diagnosis, and have usually been regarded as typical.

There is a group of molluscs agreeing with *Delphinula cancellata*, Gray, and to these must be restricted the name *Liotia*. Their relationship with the *Peronii*-like molluscs seems to me quite doubtful, and I would quite separate the latter from the true *Liotia*. There seem to be few aspirants for the vacant position. *Arene* was proposed as a sub-genus of *Liotia* by H. and A. Adams (loc. cit., p. 404) with the characters "Shell radiately painted with red; whorls muricated, the last stellate at the periphery, or angulated and keeled; peritreme more or less varicose". As species were quoted "*cruentata*, Muhl., *muricata*, Humph., and *Tamsiana*, Dkr." If we take the first species as type, according to Dall (Bull. Mus. Comp. Zool., vol. xviii, p. 386, 1889) its opercular characters are—"In *Arene cruentata* I find the operculum solid, thick, multispiral, with hardly a trace of horny matter, except at the margin. Externally it is concave, with a small central pit corresponding to a small round elevation on the inner side." The only other name I can trace applicable to the *Peronii* group is *Liotina*, introduced by Fischer (Man. de Conch., p. 831, 1885) as of Munier-Chalmas, the type of which is the fossil *L. Gervillei*, DeFrance. Of course we do not know the opercular characters of the fossil, but conchologically the

recent and fossil shells agree well. It will cause little confusion to accept this name, and I do not think much objection can be urged against its adoption. It is certainly more appropriate to the *Peronii* shells than *Liotia*.

QUOYIA.

In the Ency. Méthod. Vers., vol. ii, 1832, after p. 552 is included a tabular system of molluscs, and therein, next to *Planaxe*, is included *Quoyie*. No Latin equivalents are given, yet it would appear that this has been quoted by some writers, e.g. Tryon, as the introduction of *Quoyia*.

In the Zoology of Beechey's Voyage, 1839, Molluscs Animals, p. 125, Gray gave a description of the genus *Quoyia*, neither ascribing it to anyone nor claiming it as new. In the Proc. Zool. Soc. Lond., 1847, p. 138, Gray quoted it as "*Quoyia*, Desh. MSS., 1830; Gray, 1839; *Planaxis decollatus*, Quoy and Desh." As a synonym of this genus is given *Fissilabria*, T. Brown, Edin. Jour. Nat. Hist., 1836. It was this entry, which Mr. C. Davies Sherborn kindly brought to my notice, that caused this inquiry. The Edinburgh Journal of Natural History and Physical Sciences has upon the title-page "Conducted by William Macgillivray", and as the article in question is unsigned I conclude the genus should be credited to Macgillivray. I have been unable to trace the origin of its reference to Brown further than Gray, as above.

Macgillivray called the genus *Fissilabia*, the species name selected being *fasciata*; three fair recognizable features are given, and its habitat was supposed to be New Holland. Consequently *Fissilabia* must displace *Quoyia*, but the species name will remain *decollata*, as Quoy and Gaimard's name has priority. Thus we have *Fissilabia*, Macgillivray, 1836 = *Quoyia*, Gray, 1839. Type: *F. fasciata*, Macgil. = *Planaxis decollata*, Quoy & Gaimard, 1833 (Zool. de l'Astrol., Zool., vol. ii, p. 489).

ADEORBIS.

Sacco (I Mollus. Terr. Terz. Piemonte, pt. xxi, p. 55, 1896) has pointed out that *Tornus*, Turton, 1829, was introduced for *Helix subcarinatus*, Montagu. I have been unable to verify this statement and have not seen any refutation. If it be correct, then *Tornus* must replace *Adeorbis* (as Sacco proposed), which was not introduced by Searles Wood until 1842 (Ann. Mag. Nat. Hist., ser. i, vol. ix, p. 530). Four species were included in *Adeorbis*; the first was described as *striatus*, and figured on pl. v, figs. 4-6; the next two are nude names; the last was *subcarinatus*, Montagu. By all the laws the first should have been accepted as type, but Gray in the Proc. Zool. Soc. Lond., 1847, designated *subcarinatus* as type, and this designation has been followed. Consequently *Adeorbis* would become a pure synonym of *Tornus*. Sacco incorrectly has used *Adeorbis* for the shells typified by *striatus*, which Searles Wood himself identified with *Valvata striata*, Philippi (Enum. Moll. Sicil., vol. i, p. 147, pl. ix, figs. 3a-c, 1836). This species was later made the type of a new genus, *Circulus*, by Jeffreys (Brit. Conch., vol. iii, p. 315, 1865).

I have put these facts forward as it seems important that Sacco's discovery should be confirmed or otherwise, and *Adeorbis* placed upon a secure basis or rejected.

ILAIRA.

Introduced as a subgenus of *Liotia* (Gen. Rec. Moll., 1854, p. 405) for the species *Delphinula evoluta*, Reeve, this name has given trouble owing to the similarity of the diagnosis to shells commonly referred to *Omalaxis*. I have pointed out that 'Omalaxoid' shells have anastrophic apices. The type lot of *evoluta*, though superficially similar to some 'Omalaxoid' shells, as instance *Pseudomalaxis Macandrewi*, Iredale, differ *in toto* when critically examined. They retain their opercula, which at once separates them from that group, as it is horny, multispiral. From *Discosolis nobilis*, Verrill, they are differentiated by their apices; in *Ilaira evoluta* the apex is minute and dextral.

The shells are quite solid and have the character of *Liotina*, and I am inclined to endorse the action of the brothers Adams in placing them near that genus. They quite recall such a shell as *Liotina discoidea*, Reeve.

HALIOTIS.

In his Conch. Syst., vol. ii, 1810, Montfort introduced *Padollus* for *rubicundus*, pp. 114-15, and retained *Haliotis* for *asininus*, pp. 118-19. He definitely stated "Espèce servant de type au genre", so that it seems to me that Montfort's action must be accepted, as *asininus* is one of the original Linnean species. Pilsbry, in the Man. Conch., vol. xii, p. 75, 1890, accepted Gray's designation of 1847, and treated Montfort's *Haliotis* as a new genus. But I believe that view to be incorrect, and that we must follow Montfort in his separation of the genus *Haliotis*.

NEWTONIELLA.

Cossmann (Ann. Soc. Roy. Malac. Belg., vol. xxviii, for the year 1893, p. 18) proposed *Newtoniella* to replace his own *Newtonia* (Annuaire Géol., vol. viii, 1891, p. 721), preoccupied. *Newtonia* was provided as a substitute for *Cerithiella*, Verrill (Trans. Conn. Acad., vol. v, p. 522, 1882), which itself had been introduced on account of the name *Lovenella*, Sars (Moll. Reg. Arct. Norv., p. 187, 1878), being ineligible through a prior use of that name. The type of *Lovenella* was *Cerithium metula*, Lovén, and as no other type was designated at the times of introduction, consequently that species became the type of *Cerithiella*, *Newtonia*, and *Newtoniella*. In the Ann. Soc. Roy. Malac. Belg. for the year 1896 (1899), p. 29, Cossmann named *Cerithium clavus*, Lamarck, as type of *Newtoniella*, but that action cannot be recognized. Without a true knowledge or appreciation of the facts *Newtoniella* has been allowed to gain an entry into recent conchological literature.

Cossmann claimed that *Cerithiella*, Verrill, was invalidated by *Ceritella*, Morris & Lycett (Mon. Gt. Ool. Moll., Palæont. Soc., 1850, p. 37), and in my opinion the two names are sufficiently

distinct for both to stand. Consequently, according to the nomenclatorial laws at present in force, *Newtoniella* must be rejected, and *Cerithiella*, Verrill, be restored. When looking into this matter I met with a paper in the Rev. Critique Paléozool., vol. iv, 1900, in which Cossmann added rather notably to the already burdened synonymy of recent conchology. The title of this paper, "Rectifications de Nomenclature," seemed to me inappropriate. On p. 42 M. Cossmann proposed *Garrettia* to replace *Libera*, Garrett, which he contended was preoccupied by *Libera*, de Haan, 1825. But six years previously Pilsbry (Man. Conch., ser. II, vol. ix, p. 23), working on the genus *Libera*, Garrett, noticed de Haan's use and wrote "which was not proposed as a generic name, and is in no sense such". Reference to de Haan's work proved the accuracy of Pilsbry's statement, and the superfluity of Cossmann's introduction. Moreover, *Garrettia* had been previously used by Semper.

Cossmann next invented *Porcupinia* to be used for *Tharsis*, Jeffreys, preoccupied but three years before Miss Bush (Trans. Conn. Acad., vol. x, p. 113), working upon these molluscs, had introduced *Tharsiella*, so that Cossmann's name is another synonym.

Perhaps the most interesting (I had nearly used a stronger word) case is on the next page, when Cossmann concocted *Tiberiola*, under the impression that *Tiberia*, Jeffreys, was preoccupied by *Tiberia*, Monterosato, whereas they were both used for the same shell, Monterosato crediting it to Jeffreys MS.!

Cossmann also provided *Hoylia*, as he urged *Histiopsis*, Hoyle, was ineligible on account of a prior *Histiops*. This has been a debatable point, so I would here give Cossmann the benefit of the doubt. In the preceding cases I consider that Cossmann's action merits condemnation.

RAFINESQUE'S *ANALYSE DE LA NATURE*, 1815.

This work, which appears to be a very scarce one, has been recently brought into prominence through the fact that some of the names proposed in it have to be used owing to the ineligibility of some commonly accepted names. I had great difficulty in seeing this book and therefore consider a few notes may be acceptable, and also give a list of the valid names proposed by Rafinesque. This writer proposed a classification of Nature, introducing new names for almost all his groups. Thus the Mollusca appear as Classe Apalosia, which he divided into two Sous-Classes Cephadelia and Acephalia. The Cephadelia he divided into four orders, Cephalopodia, Pteropodia, Gasteropodia, and Spironotia; the Acephalia into two orders, Bivalvia and Poleteria. Then numerous minor divisions are all named, and then the names of the genera he recognized follow. No descriptions are offered, and all the names he claims as his own are followed by R. Fortunately the majority of these names are nude and hence of no consequence; but unfortunately when the look, formation, or sound of a prior name did not please him he proposed a substitute, and in all the cases when the offending name is correctly cited so must the substitute be considered.

The names correctly (!) proposed by Rafinesque in the Mollusca are as follows:—

- p. 140. *Ceramus*, R., for *Ammonoceratites*, Lam.
Pachynus, R., for *Hippurites*, Lam.; *Cornucopia*, Thomson.
- p. 141. *Clione*, R., for *Clio*, Brown.
Pleuropus, R., for *Scyllæa*, L.; *Glaucus*, Lam.
- p. 142. *Agenor*, R., for *Acera*, Cuv.
Euphurus, R., for *Tritonia*, Lam.
Bullinia, R., for *Bullea*, Lam.
Bullaria, R., for *Bulla*, L.
Conchulus, R., for *Concholepas*, Lam.
- p. 143. *Phymotis*, R., for *Stomatella*, Lam.
Puparia, R., for *Pupa*, Lam.
Amphibulia, R., for *Amphibulimus*, Lam.
- p. 144. *Melanidia*, R., for *Melania*, Lam.
Physina, R., for *Physa*, Drap.
Colyma, R., for *Helicina*, Lam.
Bolina, R., for *Phasianella*, Lam.
Laphrostoma, R., for *Neritina*, Lam.
Viviparella, R., for *Vivipara*, Lam.
Praxidice, R., for *Delphinula*, Lam.
Turbonus, T., for *Turbo*, L.
- p. 145. *Cassinia*, R., for *Cassis*, Brug.
Iæramea, R., for *Fasciolaria*, Lam.
Hallirhea, R., for *Pyrula*, Lam.
Fusinus, R., for *Fusus*, Lam.
Nassaria, R., for *Nassa*, Lam.
Terebraria, R., for *Terebra*, Brug.
Harparia, R., for *Harpa*, Lam.
Peristera, R., for *Columbella*, Lam.
Mitraria, R., for *Mitra*, Lam.
Olivaria, R., for *Oliva*, Brug.
Terebrina, R., for *Terebellum*, Lam.
Conulus, R., for *Conus*, L.
- p. 146. *Solenaria*, R., for *Solen*, L.
Myarina, R., for *Mya*, L.
Amathusia, R., for *Panorpa*, Lam.
Cycladea, R., for *Cyclas*, Lam.
- p. 147. *Heterocarda*, R., for *Cardita*, Brug.; *Glossus*, Poli.
Capsaria, R., for *Capsa*, Lam.
Trigella, R., for *Trigonia*, Brug.
Migonitis, R., for *Erycina*, Lam.
Unionea, R., for *Unio*, Brug.
Arcaria, R., for *Arca*, L.; *Daphne*, Poli.
Pernaria, R., for *Perna*, Brug.
Pinnula, R., for *Pinna*, L.; *Chimera*, Poli.
Malleolus, R., for *Malleus*, Lam.
Cuculina, R., for *Cucullea*, Lam.
Limella, R., for *Lymnea*, Poli.
Pedinus, R., for *Pedum*, Lam.
Limaria, R., for *Lima*.
- p. 148. *Pecten*, R., for *Pecten*, Brug.
Calceolina, R., for *Calceola*, Lam.
Cranicella, R., for *Crania*, Lam.
Cameola, R., for *Chama*, L.

The most irritating feature of this work is that though many of these substitute names are valueless as such, they are valid as incapacitating later correctly introduced names. The insecurity of

names due to such prior substitutes, until the whole of Rafinesque's names are exploited, is exemplified in his other classes. I looked through the multitude of names, and noted three (there are possibly many more) bearing on Mollusca.

On p. 118 *Amycla*, R., will invalidate *Amycla*, H. & A. Adams. On p. 123 *Amalthea*, R., settles the question of the use of *Amalthea*, Schumacher, 1817, in view of the prior *Amaltheus*, Montfort, 1810. On p. 127 *Lucina*, R., is much later than the currently accepted Molluscan *Lucina*, Brug. As noting Rafinesque's careless handling of his names, on p. 119 he proposed *Amathusa*, on p. 127 he included *Amathusia*, Fabr., and on p. 146 again uses *Amathusia* as above! I also noted *Cinclus* was used thrice!

A COLLATION OF J. C. CHENU'S *ILLUSTRATIONS CONCHYLOGIQUES*, AND A NOTE ON P. L. DUCLOS' *HIST. NAT. GÉN. ET PART. COQUILLES*.

By C. DAVIES SHERBORN, F.Z.S., and EDGAR A. SMITH, I.S.O.

Read 13th January, 1911.

IN 1882 one of us made a list of the contents of the parts of Chenu from a copy then existing in the British Museum, while in 1909 the other was indebted to Messrs. Wheldon for a sight of a second copy in which vols. 1-3 were in paper covers and vol. 4 in original parts. This material, together with a number of other notes, now enables us to give a definite collation and series of dates for Chenu's work.

The dates of receipt of the parts at the British Museum and their contents will be found in the front of the following table, while the date in black figures at the end of each paragraph indicates the date of publication as deduced from all the evidence before us.

Parts.			
1	(9, ii, 1843)	<i>Aspergillum</i> , pp. 1-4, pls. 1-5	24, xii, 1842
2	(9, ii, 1843)	<i>Arenicola</i> and <i>Chætopterus</i> , pp. 1, 2, pl. 1; <i>Siliquaria</i> , pl. 1; <i>Dentalium</i> , pl. 1; <i>Panopæa</i> , pls. 1, 2	24, xii, 1842
3	(11, v, 1843)	<i>Siliquaria</i> , pp. 1-4; <i>Sigaretus</i> , pl. 2; <i>Spirorbis</i> , pls. 1, 2; <i>Coronula</i> , pl. 2; <i>Dentalium</i> , pl. 2	1843
4	(11, v, 1843)	<i>Arenicola</i> and <i>Siliquaria</i> , ¹ pp. 11, 12; <i>Siliquaria</i> , pl. 2; <i>Balanus</i> , pls. 2, 3; <i>Dentalium</i> , pls. 3, 6	1843
5	(11, v, 1843)	<i>Sigaretus</i> , pp. 1-4, pls. 1, 3; <i>Solen</i> , pl. 4; <i>Dentalium</i> , pls. 4, 5	1843
6	(11, v, 1843)	<i>Panopæa</i> , pp. 1-4, pl. 4; <i>Solen</i> , pl. 1; <i>Sabellaria</i> , pl. 8; <i>Terebella</i> , pl. 4; <i>Amphitrite</i> , <i>Pherusa</i> , <i>Terebella</i> , <i>Pectinaria</i> , <i>Siphostoma</i> , and <i>Ditrupa</i> , pl. 7	1843
7	(undated)	<i>Panopæa</i> , pp. 5-8, pl. 8; <i>Terebella</i> and <i>Sabellaria</i> , pl. 3; <i>Pectinaria</i> , <i>Sabellaria</i> , <i>Pherusa</i> , and <i>Siphostoma</i> , pl. 2; <i>Amphitrite</i> , pl. 6; <i>Terebella</i> and <i>Amphitrite</i> , pl. 5	1843
8-10	(10, viii, 1843)	<i>Sabellaria</i> , pp. 1, 2; <i>Sigaretus</i> , pp. 5-8; <i>Clymene</i> , pp. 1, 2; <i>Cytherea</i> , pls. 5, 9; <i>Solen</i> , pls. 2, 3, 5, 6; <i>Panopæa</i> , pls. 3, 7, 9, 12; <i>Lutraria</i> , pl. 2; <i>Spondylus</i> , pl. 6; <i>Coronula</i> , pl. 3; <i>Lepas</i> , etc., pls. 1, 3	1843
11	(undated)	<i>Spirorbis</i> , pp. 1-4; <i>Cassis</i> , pl. 1; <i>Polylepas</i> , etc., pl. 2; <i>Sigaretus</i> , pl. 4; <i>Panopæa</i> , pls. 10, 11	1843

¹ All text of *Siliquaria* was issued in 1843 (this is evidently our omission).

Parts.			
12, 13	(undated)	<i>Balanus</i> , pl. 4; <i>Spirorbis</i> , p. 5, pl. 3; <i>Magilus</i> , pp. 1, 2, pl. 1; <i>Solen</i> , pl. 7; <i>Panopæa</i> , pls. 5, 6; <i>Natica</i> , pls. 2, 3; <i>Clavagella</i> , pp. 1-5, pl. 1; <i>Pholadomya</i> , pl. 1	1843
14, 15	(undated)	<i>Creusia</i> and <i>Pyrgoma</i> , pl. 1; <i>Pholas</i> , pl. 3; <i>Vermetus</i> , pl. 1; <i>Mactra</i> , pl. 1; <i>Clavagella</i> , pls. 2, 3; <i>Pentelasmis</i> , etc., pl. 4; <i>Spondylus</i> , pls. 16-18	1843
16	(7, xii, 1843)	<i>Sigaretus</i> , pp. 9-12; <i>Poronia</i> , pp. 1-3; <i>Glycimeris</i> , p. 1; <i>Tubicinella</i> , p. 1; <i>Corbis</i> , p. 1; <i>Strombus</i> , pl. 1; <i>Spondylus</i> , pl. 7; <i>Balanus</i> , pls. 5, 6; <i>Magilus</i> , pl. 2	1843
17	(7, xii, 1843)	<i>Pecten</i> , pp. 1-4; <i>Spondylus</i> , pls. 1, 9, 20; <i>Strombus</i> , pl. 2; <i>Crassatella</i> , pl. 4	1843
18, 19	(7, xii, 1843)	<i>Pedum</i> , p. 1; <i>Coronula</i> , p. 1, pl. 1; <i>Pecten</i> , pp. 5-8; <i>Tellina</i> , pl. 1; <i>Mactra</i> , pl. 2; <i>Natica</i> , pl. 4; <i>Solen</i> , pl. 8; <i>Tubicinella</i> , pl. 1; <i>Spondylus</i> , pls. 2, 8, 10; <i>Crassatella</i> , pl. 5	1843
20, 21	(7, iii, 1844)	<i>Ungulina</i> , pp. 1, 2; <i>Hinnites</i> , p. 1; <i>Galathea</i> , p. 1; <i>Spondylus</i> , pls. 11-13, 19, 21; <i>Sanguinolaria</i> , pl. 2; <i>Psammobia</i> , pl. 1; <i>Corbis</i> , pl. 2; <i>Ficus</i> , pl. 1; <i>Glycimeris</i> , pl. 1	1844
22	(7, iii, 1844)	<i>Sigaretus</i> , pp. 13-20; <i>Spondylus</i> , pls. 3, 22	1844
23, 24	(5, vi, 1844)	<i>Syndosmya</i> , pp. 1-4; <i>Spondylus</i> , pls. 14, 23; <i>Strombus</i> , pl. 3; <i>Sanguinolaria</i> , pl. 1; <i>Cerithium</i> , pl. 1; <i>Pecten</i> , pls. 26, 42, 43; <i>Vermetus</i> , pls. 2, 3	1844
25	(undated)	<i>Sigaretus</i> , pp. 21-4; <i>Spondylus</i> , pls. 4, 5, 15, 24-6; <i>Pecten</i> , pls. 5, 14; <i>Mactra</i> , pl. 3	1844
26, 27	(5, vi, 1844)	<i>Strombus</i> , pp. 1-8; <i>Spondylus</i> , pls. 28, 29; <i>Pecten</i> , pls. 2, 8, 3, 4, 44-6; <i>Cassis</i> , pl. 2; <i>Vermetus</i> , pl. 4; <i>Dentalium</i> , pl. 7	1844
28	(26, vii, 1844)	<i>Strombus</i> , pp. 9-16; <i>Pecten</i> , pls. 9, 10, 23, 13, 12; <i>Vermetus</i> , pl. 5	1844
29, 30	(26, vii, 1844)	<i>Oliva</i> , pp. 5-12 [see pt. 79]; <i>Pecten</i> , pls. 49, 18, 19, 17, 27, 33, 47, 48; <i>Spondylus</i> , pls. 27, 30; <i>Strombus</i> , pls. 20, 27	1844
31, 32	(17, i, 1845)	<i>Oliva</i> , pp. 13-20; <i>Pecten</i> , pls. 15, 51, 50, 53, 52; <i>Strombus</i> , pls. 26, 10, 13, 16, 22, 23, 25	1844
33, 34	(17, i, 1845)	<i>Oliva</i> , pp. 21-8; <i>Strombus</i> , pls. 8, 4, 28, 30, 12, 18; <i>Pecten</i> , pls. 24, 6; 54, 55; <i>Serpula</i> , pls. 5, 6	1844
35	(12, vi, 1845)	<i>Oliva</i> , pp. 29-31; <i>Strombus</i> , p. 17, pls. 7, 6, 21, 15; <i>Serpula</i> , pls. 8, 7	1845
36, 37	(12, vi, 1845)	<i>Ervilia</i> , pp. 1-4; <i>Lutraria</i> , pl. 1; <i>Pecten</i> , pls. 22, 21, 11; <i>Strombus</i> , pls. 24, 11, 9, 5; <i>Serpula</i> , pls. 1, 2, 4, 3	1845
38	(12, vi, 1845)	<i>Spondylus</i> , pp. 1-4, pl. 31; <i>Strombus</i> , pls. 29, 14, 17; <i>Ungulina</i> , pl. 1; <i>Diceras</i> , pl. 3	1845
39	(12, vi, 1845)	<i>Spondylus</i> , pp. 5-8, pl. 32; <i>Strombus</i> , pl. 19; <i>Pecten</i> , pls. 25, 39, 31; <i>Diceras</i> , pl. 1	1845
40	(12, vi, 1845)	<i>Diceras</i> , pp. 1-4; <i>Pecten</i> , pls. 16, 20, 32; <i>Pedum</i> , pl. 1; <i>Diceras</i> , pls. 2, 4	1845

Parts.			
41	(12, vi, 1845)	<i>Lavigno</i> , pp. 1-4; <i>Pecten</i> , pls. 30, 7, 35, 29; <i>Oliva</i> , pls. 7, 2	1845
42	(12, vi, 1845)	<i>Lavigno</i> , pp. 5-8; <i>Oliva</i> , pls. 19, 11, 13, 29, 21, 20	1845
43	(12, vi, 1845)	<i>Lavigno</i> , pp. 9-11; <i>Spondylus</i> , p. 9; <i>Oliva</i> , pls. 27, 8, 9, 28, 17, 18	1845
44	(11, xii, 1845)	<i>Tridacna</i> , pp. 1, 2; <i>Oliva</i> , pls. 34, 4, 12, 26, 30, 33	1845
45	(11, xii, 1845)	<i>Oliva</i> , pls. 1, 6, 35; <i>Galathea</i> , pl. 1; <i>Physa</i> , pl. 1; <i>Corbis</i> , pl. 1	1845
46	(undated)	<i>Tridacna</i> , pls. 6-8; <i>Oliva</i> , pls. 14-16	1845
47	(14, ii, 1846)	<i>Oliva</i> , pls. 3, 23, 31, 36; <i>Chama</i> , pls. 7, 8	1845
48	(14, ii, 1846)	<i>Oliva</i> , pls. 32, 25, 22, 24, 10, 5	1845
49, 50	(14, ii, 1846)	<i>Mycetopus</i> , p. 1; <i>Cleidothærus</i> , p. 1; <i>Tridacna</i> , pls. 1, 3-5; <i>Poronia</i> , pl. 1; <i>Unio</i> , pls. 16, 8; <i>Vermetus</i> , pl. 5; <i>Trigonia</i> , pl. 4; <i>Pinna</i> , pls. 8, 7	1845
51, 52	(undated)	<i>Pecten</i> , pls. 58, 56, 57; <i>Trigonia</i> , pl. 5; <i>Unio</i> , pls. 13, 18, 11; <i>Serpula</i> , pls. 9, 10, 12, 11; <i>Pinna</i> , pl. 9	1846
53, 54	(13, vii, 1846)	<i>Ligula</i> , pp. 1-4; <i>Mycetopus</i> , pl. 1; <i>Iridina</i> , pl. 1; <i>Panopæa</i> , pls. (suppl.) 14, 13; <i>Hippurites</i> , pl. 1; <i>Crania</i> , pls. 3, 1, 2; <i>Unio</i> , pls. 15, 10, 14, 12	1846
55	(13, vii, 1846)	<i>Narica</i> , pp. 1-4; <i>Chama</i> , pl. 3; <i>Galathea</i> , pl. (suppl.) 2; <i>Ficus</i> , pl. 4; <i>Pholadomya</i> , pls. 2-4	1846
56	(13, vii, 1846)	<i>Narica</i> , pp. 5-8; <i>Unio</i> , pl. 9; <i>Ficus</i> , pls. 2, 3; <i>Hippurites</i> , pl. 2; <i>Pholadomya</i> , pls. 5, 6	1846
57	(13, vii, 1846)	<i>Narica</i> , pp. 9-12; <i>Chama</i> , pl. 1; <i>Trigonia</i> , pl. 1; <i>Cleidothærus</i> , pl. 1; <i>Unio</i> , pl. 17; <i>Pholadomya</i> , pls. 8, 7	1846
58	(12, xi, 1846)	<i>Unio</i> , pls. 21, 19, 22; <i>Pholadomya</i> , pls. 13, 12, 10	1846
59	(undated)	<i>Chama</i> , pl. 2; <i>Unio</i> , pls. 24, 20; <i>Pholadomya</i> , pls. 9, 15, 11	1846
60, 61	(undated)	<i>Unio</i> , pls. 23, 25; <i>Columbella</i> , pls. 11, 7, 9; <i>Lima</i> , pls. 4, 3, 5-7; <i>Pholadomya</i> , pl. 14; <i>Venericardia</i> , pl. 2	1846
62	(13, iv, 1847)	<i>Columbella</i> , pls. 2, 6, 3, 8, 10, 12	1846
63	(undated)	<i>Chama</i> , pl. 5; <i>Malleus</i> , pl. 1; <i>Columbella</i> , pls. 1, 4, 5, 18	1846
64	(13, iv, 1847)	<i>Cytherea</i> , pl. 8; <i>Chama</i> , pl. 6; <i>Malleus</i> , pl. 2; <i>Chama</i> , pl. 4; <i>Nautilus</i> , pls. 3, 4	1846
65	(13, iv, 1847)	<i>Chama</i> , pl. 7; <i>Cytherea</i> , pl. 14; <i>Columbella</i> , pls. 16, 17; <i>Nautilus</i> , pls. 2, 5	1846
66	(13, iv, 1847)	<i>Columbella</i> , pls. 14, 13, 15; <i>Unio</i> , pl. 33; <i>Paludina</i> , pl. 1	1846
67	(undated)	<i>Unio</i> , pls. 29, 32, 31, 26; <i>Argonauta</i> , pl. 2; <i>Ammonites</i> , pls. 1, 2	1847
68	(undated)	<i>Placuna</i> , pl. 1; <i>Unio</i> , pls. 27, 28, 30; <i>Ammonites</i> , pls. 3, 4	1847
69	(2, vii, 1847)	<i>Placuna</i> , pls. 2, 3; <i>Cytherea</i> , pls. 13, 1; <i>Ammonites</i> , pls. 5, 6	1847
70	(2, vii, 1847)	<i>Cytherea</i> , pls. 2, 11, 12; <i>Venus</i> , pl. 7; <i>Ammonites</i> , pls. 7, 8	1847
71	(undated)	<i>Cytherea</i> , pl. 10; <i>Helix</i> , pl. 25; <i>Venus</i> , pls. 1, 8; <i>Ammonites</i> , pls. 9, 10	1847

Parts.			
72	(undated)	<i>Leptoxis</i> , pl. 1; <i>Fissurella</i> , pl. 1; <i>Helix</i> , pl. 12; <i>Conus</i> , pl. 4; <i>Ammonites</i> , pl. 11	1847
73	(8, xi, 1847)	<i>Cyclostoma</i> , pl. 1; <i>Leptoxis</i> , pls. 2, 3; <i>Cytherea</i> , pl. 6; <i>Ammonites</i> , pls. 12, 14, 15	1847
74	(8, xi, 1847)	<i>Leptoxis</i> , pls. 4, 5; <i>Patella</i> , pl. 1; <i>Monodonta</i> , pl. 1; <i>Ammonites</i> , pls. 15, 16	1847
75	(15, iii, 1848)	<i>Ostrea</i> , pl. 3; <i>Venus</i> , pl. 6; <i>Melania</i> , pl. 2; <i>Nautilus</i> , pl. 1; <i>Ammonites</i> , pls. 18, 19	1847
76	(undated)	<i>Columbella</i> , pls. 20, 23; <i>Venus</i> , pl. 5; <i>Ostrea</i> , pl. 2; <i>Ammonites</i> , pls. 22, 21	1848
77, 78	(6, vii, 1848)	<i>Leptoxis</i> , pp. 1-6; <i>Narica</i> , p. 13; <i>Crassatella</i> , pl. 2; <i>Columbella</i> , pls. 27, 22, 25, 19, 24, 21; <i>Psammobia</i> , pl. 1; <i>Haliotis</i> , pl. 3; <i>Ammonites</i> , pl. 17, 20, 23	1848
79	(6, vii, 1848)	<i>Oliva</i> , pp. 1-4; <i>Helix</i> , pl. 1; <i>Cyrena</i> , pl. 2; <i>Tellina</i> , pl. 5; <i>Trochus</i> , pl. 5; <i>Ammonites</i> , pls. 25, 26	1848
80	(undated)	<i>Helix</i> , pls. 2, 4; <i>Ampullaria</i> , pl. 3; <i>Bulimus</i> , pl. 9; <i>Ammonites</i> , pls. 24, 27	1850
81	(undated)	<i>Helix</i> , pl. 3; <i>Bulimus</i> , pl. 8; <i>Anodonta</i> , pl. 3; <i>Trochus</i> , pl. 4; <i>Columbella</i> , pl. 26	1850
82, 83	(5, ix, 1851)	<i>Dentalium</i> , pp. 1-4; <i>Marginella</i> , pls. 1-3; <i>Pectunculus</i> , pl. 2; <i>Helix</i> , pls. 10, 5, 8, 5 (bis)	1850
84	(3, vi, 1852)	<i>Dentalium</i> , pp. 5-8; <i>Avicula</i> , pl. 2; <i>Helix</i> , pls. 8 (bis), 7, 6; <i>Narica</i> , pl. 1	1852
85	(5, iii, 1853)	<i>Conus</i> , pl. 1; <i>Harpa</i> , pls. 1-4	1853

Exigency of space forbids us from listing the genera, text, and plates in proper order.

Duclos' work, *Hist. nat. gén. et part. de tous les genres de Coquilles Univalves Marines* . . . , as its title magnificently set forth, partly monographed three genera, and was published as follows:—

Genre OLIVE. Six parts.

1 and 2. Two sheets of text and twelve plates were received by the Academy of Sciences, Paris, in November, 1835.

3-6. Plates 13-33 were received by the Academy in February and March, 1840.

Genre COLOMBELLE. Two parts.

1 and 2. One sheet of cover and thirteen plates were printed in 1835 and published in April, 1840 (Bibl. Française).

Genre STROMBE. Twenty-five unpublished plates in the British Museum (Nat. Hist.) carry the following note:—"Ne. Ces planches, telles qu'elles sont ici, n'ont jamais vu le jour, M. Duclos les ayant abandonnées pour les faire paraître avec augmentation dans les Illustrations Conchyliologiques de M. Chenu.

Achetées à la vente de Duclos.

Dr. B."

DESCRIPTION OF A NEW SPECIES OF *HELICODONTA* FROM TENERIFE.

By G. K. GUDE, F.Z.S.

Read 13th January, 1911.

AMONG a number of land shells collected in 1909 and 1910 by Dr. J. H. Salter in Tenerife, and submitted to me for identification, a form was observed which appears to be undescribed.

Compared with *Helicodonta fortunata*, Shutt., its nearest ally, the new species is at once separated by its more elevated spire and narrower umbilicus; the whorls are also more convex, both above and below, whilst the peripheral keel is not pinched as in that species; the costulae are much less pronounced, and the columellar margin of the peristome is more curved. The principal feature, however, in which it differs lies in the granules, which are lacking in *H. fortunata*.

In appending a diagnosis of the new species I have much pleasure in associating with it the name of its discoverer.

HELICODONTA SALTERI, n.sp.

Shell moderately umbilicated, conoid, solid, light rufous above, paler below, especially towards the umbilicus; nepionic whorls finely granulated, the remainder closely covered with fine curved riblets, and densely infested with granules arranged in quincunx above, but somewhat irregularly below. Spire pyramidal; apex acute; suture linear. Whorls 5, slightly flattened above, convex below, obtusely carinated at the periphery, and obtusely angulated round the umbilicus, increasing regularly, the last nearly twice as



wide as the penultimate, shortly deflexed in front, and slightly constricted behind the peristome. Aperture semi-rotundate, oblique, margins approaching, united by a thin callus on the parietal wall. Peristome scarcely thickened, reflexed, whitish, upper margin slightly curved, basal rounded, columellar ascending, and slightly dilated. Umbilicus moderately wide and deep, showing a portion of the penultimate whorl. Diam. maj. 12, min. 10.5 mm.; alt. 6 mm.

Hab.—Tenerife, Canary Islands. Type in my collection.

NOTE ON SOME PREOCCUPIED MOLLUSCAN GENERIC NAMES AND
PROPOSED NEW GENERA OF THE FAMILY ZONITIDÆ.

By G. K. GUDE, F.Z.S.

Read 13th January, 1911.

WHEN Professor Pilsbry in 1894 published his classification of the Helicidæ—which, with its masterly grasp of detail, in many instances revolutionized our previous conception of the inter-relations of this enormous group of land shells—many malacologists were led to hope that the remaining Helicoids would in due course receive similar treatment from his able pen. These hopes, however, have not been realized, and a satisfactory systematic arrangement of this numerous group as yet remains a desideratum.

The classification of these molluscs adopted in Pfeiffer's *Nomenclator* is in many cases, of necessity, somewhat antiquated, while the arrangement of the Naninidæ by Dr. G. Pfeiffer¹ does not appear to have met with much approval. An important step in the right direction was made by the late W. T. Blanford, with the co-operation of Lieut.-Colonel Godwin-Austen, in the first volume of the *Mollusca of The Fauna of India*, and by the latter in *The Mollusca of India*. This, however, covers but a comparatively small portion of the whole field, and much remains to be done.

In attempting a workable scheme of classification of the Helicoids, other than the Helicidæ proper, I do not profess to fill this lacuna. The arrangement which I hope shortly to present for publication will simply be a preliminary synopsis, and will be based mainly on conchological and geographical data.

In the course of my search through literature in this connexion several generic or sectional names were found to be preoccupied in other branches of zoology, and new names are now proposed in lieu of these. Although two of the genera in question do not strictly come within the scope of the present paper, pertaining as they do to the family Helicidæ, it has been considered expedient to include them here. A number of species, hitherto assigned to various genera from time to time by different authors, were considered sufficiently distinct from their whilom congeners to warrant the creation of new genera for their reception, and the names for these are also appended.

To Mr. J. H. Pousonby, whose unrivalled knowledge of the Helicoids is always so ungrudgingly placed at my service, I am indebted on this, as on so many previous occasions, for many valuable hints and suggestions.

ZOPHOS,² n.n.

In the year 1860 no less than three genera were named after the celebrated Danish conchologist Mörch. Arthur Adams proposed *Mörchia* for marine shells in the *Annals and Magazine of Natural*

¹ Abh. Naturw. Ver. Hamburg-Altona, vol. vii, Abt. ii, p. 1, 1883.

² ζῶφος, darkness.

History, ser. III, vol. v, pt. iv,¹ published in April. E. von Martens utilized the name in *Die Heliceen*, 2nd ed., p. 72, for a section of *Helix*, the only species being *H. concolor*; while Mayer associated it with a genus of fossil Streptoneura in the *Journal de Conchyliologie*, pt. iii, bearing the date July, 1860,² but probably not published until 1861. I have been unable to find the actual date at which it was issued, but the copy in the British Museum is stamped with the date "July 5th, 1861", and as this publication has, I believe, invariably been published long after the dates printed on the covers, it may safely be assumed that Mayer's name has no claim to rank; since the parts of the *Ann. Mag. Nat. Hist.* have always been issued punctually, the only question remains as to the date of *Die Heliceen*. The publisher, Mr. W. Engelmann, of Leipzig, on being questioned on this point, obligingly replied that the records of the firm have not been kept so far back, but he is sure the work was not sent out until late in the year 1860, so that Adams' name undoubtedly has priority, and for von Martens' genus I therefore propose the name *Zophos*, taking as the type *Helix concolor*, Mörch, from Porto Rico, Dominica, and Guadeloupe.

NITOR,³ n.n.

In the same work (p. 59) von Martens also defined the genus *Thalassia*, taking as type *Helix subrugata*, Pfr. Agassiz in his *Nomenclator* states that Dejean⁴ published a genus *Thalassia*, but as this work contains no diagnoses or definitions of any of the groups, and as moreover the name appears subsequently to have been altered to *Thalassa*, I intended to have retained von Martens' name. Mr. T. Iredale, however, has kindly drawn my attention to the fact that a genus of birds has been properly defined under the name *Thalassia*,⁵ and I therefore substitute the above designation.

CYCLISCUS,⁶ n.n.

In 1850 Albers proposed the name *Rotula* in *Die Heliceen*, 1st ed., for a genus containing *Helix Bensoni*, v. d. Busch, and *H. detecta*, Fér., while von Martens in the second edition restricted the genus to *H. detecta*, the other name having proved to be a synonym of *H. serrula*, Bens., a species referred to the genus *Khasiella*. The name *Rotula* being preoccupied in Echinoderma (Agassiz, *Monographie des Scutelles*, 1841, p. 23), Albers' name has to share the fate of the preceding two, and *Helix detecta*, Fér., from the Island of Bourbon becomes the type of *Cycliscus*.

NESÆCIA,⁷ n.n.

Mörch created the genus *Rotularia* in the *Journal de Conchyliologie*, vol. xx, p. 308, 1872, but the name having already been proposed for a genus of fossil Foraminifera by De France in *Dict. Sci. Nat.*,

¹ p. 301.

² p. 309.

³ *Nitor*, brightness.

⁴ *Catalogue des Coleoptères*, 2nd ed., 1834, p. 430.

⁵ Bonaparte, *Comptes Rendus Ac. Sc.*, xliii, p. 645, 1856.

⁶ κυκλίσκος, a flat cake.

⁷ νήσος, island; οἶκον, home.

vol. xlii, p. 322,¹ 1827, a new designation becomes necessary. Type *Helix Massoni*, Behn., from the Nicobar Islands.

KERÆA,² n.n.

This name is proposed for *Julus*, Wollaston, *Testacea Atlantica*, 1878, p. 80, not *Julus*, Leach, Zool. Misc., vol. iii, p. 32, 1817, a genus of Myriopoda. Type *Patula Garachicoensis*, Woll., from Tenerife, Canary Islands. Pilsbry places *Julus* as a section of *Pyramidula* (*Man. Conch.* (2), vol. ix, p. 341, 1894).

RUTHVENIA, n.n.

When this writer proposed the name *Sykesia*³ in lieu of *Austenia*,⁴ a sub-genus of *Plectopylis*, Mr. E. Ruthven Sykes pointed out that Pomel had already in 1883⁵ published a genus of Echinoderms under this appellation. Thus a new name is required for this group, and I propose that *Sykesia* be replaced by *Ruthvenia*.

Pomel's work, which contains 176 new generic names, appears to have escaped the notice of the recorders, and although a careful search has failed to reveal any other instances of names of Helicoids being invalidated by this publication, malacologists working in other divisions of Mollusca should not fail to consult the work in question in addition to the usual records.

In 1899, when splitting up the genus *Plectopylis* into several subdivisions, I expressed the opinion⁶ that when the anatomy of the species referred to this section should be investigated, they would probably be found to differ considerably from typical *Plectopylis*, and that they would rank as a separate genus. This has since been confirmed by Lieut.-Colonel Godwin-Austen, who has examined the soft parts of *Sykesia biciliata*, Pfr.,⁷ and is of opinion that it is closely related to *Thysanota*.

ARCHÆOPLECTA, n.g.

Shell trochoid, finely ribbed, margins of peristome acute, columellar margin reflected, overhanging the narrow umbilical perforation.

Nanina (Gray), auct. (in part).

Type: *Helix stenotrypta*, A. Braun, from the Lower Miocene (Aquitanean), Mayence Basin.

The type-species of this new genus has been stated by Sandberger to be related to *Eulota ravidia*, Bens., from China, but the specimens in the British Museum (Nat. Hist.), to which I have had access, do not bear out this view, as they show no trace of spiral sculpture and the columella is different in character. It bears a greater resemblance, in my opinion, to some species of *Hemiplecta*, notably *H. Everetti*, Smith,

¹ Not p. 231 as given in Scudder's *Nomenclator*.

² *κεραία*, a trifle.

³ *Science Gossip*, N.S., vol. iii, p. 332, 1897.

⁴ *Tom. cit.*, p. 300.

⁵ *Classif. méth. et gén. Éch. viv. et foss.*, p. 88.

⁶ *Science Gossip*, N.S., vol. vi, p. 149.

⁷ *Land and Freshwater Mollusca of India*, vol. ii, p. 196, 1907.

from the Malay Archipelago. In order to signalize this fact, without inferring actual relationship, I suggest the above name for this group.

ALLOGENES,¹ n.g.

Shell planorbiform, vitreous, shining; spire immersed, periphery keeled or angulated, the keel or angulation entering the median region of the aperture.

Type: *Vitrea prodigiosa*, Ancey, from Djurdjura, Algeria.

The species on which I base this new genus is so peculiar that it was compared by Ancey to *Happia ammoniformis* and *H. vitrina* from South America. It also bears some superficial resemblance to *Guestieria Powisiana* from New Grenada. *Vitrea isserica*, Let., and *V. djurdjurensis*, Deb., are congeneric with it.

DROUETIA, n.g.

Shell hyaline, very finely striated, and covered with excessively fine spirals, imperforate, the reflexed columella slightly twisted.

Type: *Helix atlantica*, Mor. & Dr., from the Azores.

A monotypic genus named in honour of the late Mons. Henri Drouet, a noted French malacologist, who described several mollusca from these islands.

HAWAIIA, n.g.

Shell zonitoid, vitreous, finely and regularly costulate, openly umbilicated.

Hyalinia and *Pseudohyalinia*, auct. (in part).

Type: *Helix Kawaiensis*, Pfr.

Confined to the Sandwich Islands.

PSICHION,² n.g.

Shell turbinate, finely striated transversely, and with microscopic close spirals. Umbilicus perforate, partly covered by the columellar margin of the peristome.

Type: *Helix miliaris*, Morel., from the Comoro Islands.

THAPSIELLA, n.g.

Shell zonitoid, shining, narrowly perforate, finely striated transversely, and covered with dense microscopic spirals, narrowly perforated, the umbilicus partly covered by the columellar margin of the peristome.

Thapsia, auct. (in part).

Type: *Thapsia Masukuensis*, Smith, from Central Africa.

Differs from *Thapsia*, the type of which is *H. troglodytes*, Morelet, in the sculpture, which is devoid of the decussation characterizing that genus. The species are nearly all small, and range over Central Africa and the east coast, whereas *Thapsia* is found on the west coast and its islands.

¹ ἄλλογενής, a stranger.

² ψῖχιον, a fragment.

ERRATUM.—By an unfortunate *lapsus calami* the type of the new genus *Hawaiiia* on p. 272 was stated to be *Helix Kawaiensis*, Pfr.; this should read *Helix Hawaiiensis*, Ancey.

G. K. GUDE.

AMPHIBLEMA,¹ n.g.

Shell trochoid, thin, finely striated, the striæ decussated by fine, slightly undulating spirals above, base more polished, and spirals much finer, umbilicus sub-covered, perforate.

Oxytes, Tryon (in part), non Benson.

Type: *Helix eucharis*, Desh., from Madagascar.

KALIDOS,² n.g.

Shell depressed, conoid, finely striated, and decussated by fine or coarse spirals, periphery rounded or angular, umbilicus small.

Rhysota, Tryon (in part), non Albers; *Xestina*, Tryon (in part), non Pfeffer.

Type: *Helix Ekongoensis*, Angas, from Madagascar.

Apparently confined to Madagascar. *Helix Cleamesi*, Smith, I also refer to this genus.

KALENDYMA,³ n.g.

Shell depressed conoid, rather solid, whorls shouldered above, with a shallow groove a little above the periphery, ascending the greater part of the spire close to the channelled suture.

Hemiplecta, Tryon, non Albers.

Type: *Helix compluviata*, Cox, from the Solomon Islands.

I know no other shell which can be classed with it. The species of *Taphrospira*, Blanford, from India bear some superficial resemblance to it.

ELAPHROCONCHA,⁴ n.g.

Shell depressed, thin, fragile, translucent corneous, amber-coloured, dull above, polished below, finely striated, last whorl dilated towards aperture, more than twice the size of the penultimate whorl, impervious.

Type: *Hemiplecta internota*, Smith, from Lombok Island, Malay Archipelago. To this genus I also refer *H. rufolineata*, Smith, and *H. Fruhstorferi*, Martens, from the same island.

ASPERITAS,⁵ n.g.

Shell trochoid, rather solid, opaque, distantly striated, covered with incised spirals and obliquely descending rugæ. Periphery acutely or obtusely keeled, umbilicus sub-covered, perforate.

Xestina and *Xesta*, auct. (in part).

Type: *Xestina rugosissima*, Möllendorff, from Roma Island, Malay Archipelago.

Helix inquinata, v. d. Busch, and *Xesta Dammaensis*, Smith, together with some other species from these islands, form a fairly homogeneous group.

¹ ἀμφίβλημα, a covering.

³ κάλός, beautiful; ἐνδύμα, garment.

⁵ *Asperitas*, roughness.

² καλεῖδος, lovely vision.

⁴ ἐλαφρός, light; κόγχη, shell.

MALACOLOGICAL SOCIETY OF LONDON.

INCOME AND EXPENDITURE FOR THE YEAR ENDED DECEMBER 31, 1910.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance—				By Cost of "Proceedings"—			
Per Current Account from				Printing and Postage . .	£87	4	8
last year	£1	5	11	Illustrations	11	17	5
From Special Fund . . .	7	7	0				
	8	12	11				
Annual Subscriptions—							
Ordinary Members . . .	£27	16	6	Printing Circulars			
Corresponding Members .	20	3	8	Treasurer (Stamps)			
				Linnean Society—			
Annual Subscriptions in arrear—	48	0	2	Expenses incurred by use			
Ordinary Members . . .	£1	11	6	of Rooms	£3	3	0
Corresponding Members .	1	19	0	Gratuities to Attendants .	2	10	0
	3	10	6				
Annual Subscriptions in advance—							
Ordinary Members . . .	£4	4	0	Secretary's Expenses			
Corresponding Members .	5	5	5	Balance in hand			
	9	9	5				
Entrance Fees	2	2	0				
Sale of "Proceedings" . .	26	1	10				
Dividends on £50 Metropolitan 2½% Stock	1	5	0				
Donations for Illustrations, etc.	15	4	8				
	£114	6	6				

20

To Balance from last year	£7 7 0	By Transferred to Current Account	£7 7 0
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We have this day examined the accounts of the Treasurer of the Malacological Society of London, and we find the above statement to be correct.

JOHN H. PONSONBY, Hon. Treasurer.

January 24, 1911.

HENRY WOODWARD }
S. PACE }
Auditors.

ANNUAL GENERAL MEETING.

FRIDAY, 10TH FEBRUARY, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Mr. A. S. Kennard and Mr. T. Iredale were appointed scrutineers.

The following report was read:—

“Your Council, in presenting their eighteenth Annual Report, are once more in a position to record a year of useful work.

“During the last twelve months ten new members have been elected. By death the Society has lost three prominent members—Professor Dr. Oscar Boettger, the Rev. R. Boog Watson, LL.D., F.R.S.E., and the Rev. G. F. Whidborne, M.A., F.G.S. Eight members have resigned, and the name of one has been removed from the list by virtue of Rule X.

“The membership of the Society on December 31, 1910, stood as follows:—

Ordinary members	.	.	.	.	.	.	68
Corresponding members	.	.	.	.	.	.	81
Total							149

“The financial condition of the Society remains substantially the same as last year, but in order not to hamper the work of publication it has been thought advisable, the same as last year, to re-transfer to current account the special fund created two years ago. The current account consequently shows a balance of £3 12s. 9d. Furthermore, the Society still holds the sum of £50 invested in Metropolitan 2½ per cent. stock.

“During the past year three parts of the ‘Proceedings’ have been issued as usual, forming the first half of the ninth volume, and comprising 224 pages illustrated with 8 plates and 58 text-figures.

“The following gentlemen have kindly contributed towards the cost of illustrations, or have supplied drawings or photographs for the text-figures and plates: The Rev. R. A. Bullen, R. H. Burne, Dr. J. C. Cox, G. K. Gude, C. Hedley, K. H. Jones, J. C. Melvill, R. B. Newton, Dr. H. A. Pilsbry, Dr. H. R. Simroth, E. A. Smith, G. B. Sowerby, and B. Walker. Without such assistance it would be impossible to illustrate the publication so fully.

“Further, the thanks of the Society are especially due to the Council of the Linnean Society, through whose kindness it has been permitted, as in former years, to hold its meetings in Burlington House.”

On the motion of Mr. A. S. Kennard, seconded by Mr. T. Iredale, the above was adopted as the Annual Report of the Society.

The following were elected as Officers and Council for 1911:—

President.—R. Bullen Newton, F.G.S.

Vice-Presidents.—Rev. R. Ashington Bullen, F.L.S.; G. C. Crick, F.G.S.; Rev. Professor H. M. Gwatkin, D.D.; B. B. Woodward, F.L.S.

Treasurer.—J. H. Ponsonby, F.Z.S., 15 Chesham Place, London, S.W.

Secretary.—G. K. Gude, F.Z.S., 45 West Hill Road, Wandsworth, London, S.W.

Editor.—E. A. Smith, I.S.O., F.Z.S., Natural History Museum, Cromwell Road, London, S.W.

Other Members of Council.—S. Pace, F.Z.S.; H. B. Preston, F.Z.S.; W. G. Ridewood, D.Sc.; H. O. N. Shaw, F.Z.S.; E. R. Sykes, B.A., F.L.S.; J. R. Le B. Tomlin, M.A.

On the motion of Mr. S. Pace, seconded by the Rev. E. W. Howell, a vote of thanks was passed to the Retiring Officers and Members of the Council, and to the Auditors and Scrutineers.

ORDINARY MEETING.

FRIDAY, 10TH FEBRUARY, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Mr. C. N. Bromehead, B.A., was elected to membership of the Society.

The President delivered his annual address, entitled "A Sketch of the chief Geological Zones and their Mollusca". On the motion of Mr. E. R. Sykes, seconded by Mr. R. H. Burne, a vote of thanks was passed to Mr. Newton for his interesting address, which it was resolved should be printed *in extenso*.

ORDINARY MEETING.

FRIDAY, 10TH MARCH, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Mr. C. M. Steenberg, M.Sc., Copenhagen, was elected to membership of the Society.

The following letter, addressed to the Secretary, was read:—

"The members of your Society will no doubt be aware that the subject of Zoological Nomenclature is attracting great attention at the present moment. In particular, the question as to how far the Law of Priority should be rigidly enforced is the theme of animated discussion, and will come before the Nomenclature Commission of the International Zoological Congress at its next meeting. It is desirable that a limited number of test cases in which great inconvenience and confusion are likely to be caused by the enforcement of the Law of Priority should be then brought up for discussion. The most urgent cases are those in which a well-known and commonly used name would be displaced by an equally well-known one which has been currently applied to some other species. I should be glad if you would call the attention of your members to this important matter, and shall be obliged for any suggestions as to names which it is desirable to bring forward for consideration.

"(Signed) WM. EVANS HOYLE.

"CITY HALL, CARDIFF.

8th February, 1911."

[The Council invites members who are interested in the subject to communicate with Dr. Hoyle.]

The Secretary, at the request of Mr. B. B. Woodward, read a letter addressed to the latter by Dr. A. C. Johansen, in which he stated that

Petricola pholadiformis has now reached the Danish coasts. In 1903 he found some dead shells of this species in the Graa Dyb at Esbjerg, while in February, 1910, he found the first living specimens at Shaltingen.

Mr. G. C. Crick exhibited a specimen of a rare Goniatite (*Glyphioceras vesiculiferum*) from the Carboniferous Limestone of Yorkshire.

The following communications were read:—

1. "On the recent species of the genus *Vulsella*." By E. A. Smith, I.S.O.

2. "On a new species of *Phasianella* from South Africa." By E. A. Smith, I.S.O.

3. "On the value of the Gastropod Apex in Classification." By T. Iredale.

4. "On *Valvata Woodwardi*, n.sp., and *Sphærium Bulleni*, n.sp., from the Cromerian (Forest Bed) of West Runton, Norfolk." By A. S. Kennard, F.G.S.

ORDINARY MEETING.

FRIDAY, 7TH APRIL, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

The following communications were read:—

1. "A list of Marine Shells occurring at Christmas Island, Indian Ocean, with descriptions of new species." By E. A. Smith, I.S.O.

2. "Description of *Oxytes Beddomei*, n.sp., from Upper Burma." By Lieut.-Colonel H. H. Godwin-Austen, F.R.S.

3. "Note on *Macrochlamys* (*Eurychlamys*) *platychlamys* (Blandford), etc." By Major A. J. Peile, R.A.

OBITUARY NOTICES.

THE REV. R. BOOG WATSON, LL.D., a member of the Malacological Society since its formation in 1893, died on June 13th, 1910, in his eighty-seventh year.

Although not a contributor to the Society's "Proceedings" he was well known to all as the author of the classic *Report on the Scaphopoda and Gasteropoda collected by H.M.S. "Challenger" during the years 1873-6*. This work consisted of 746 quarto pages of text, illustrated with 50 plates, and at once proclaimed the author one of the most careful and accurate writers of his day. In the preparation of it he spent many months comparing his specimens with the valuable collections at the British Museum, and subsequently visited some of the museums in Norway, France, and Switzerland; in fact, he left nothing undone which would help towards the accuracy and completeness of his work. The result was that he left to us a model of carefulness and thoroughness which it were well if some writers had followed.

Although at times his descriptions may be considered too prolonged, perhaps, if a fault, it was on the right side, for what is more troublesome and annoying than brief and inadequate diagnoses? His other conchological work was chiefly in connection with the fauna of Madeira, where he resided for about ten years. He published nine papers dealing with this subject, and in one of them, the last he wrote, gave a most valuable list of all the known marine mollusca of the islands, together with descriptions of thirty-five new species (Journ. Linn. Soc., 1897, vol. xxvi, pp. 233-329, 2 pls.).

Highly cultured, a classical scholar, and a most amiable personality, the Rev. R. Boog Watson will be held in pleasant remembrance by all those who had the enjoyment of his acquaintance or friendship.

E. A. S.

At the meeting in November last the President referred in the following terms to the loss the Society had sustained through the death of one of its members.

"It is with deep regret that I have to announce the death of Professor Dr. OSCAR BOETTGER, which took place last September, in his sixty-seventh year. Professor Boettger was one of our most distinguished foreign members, and had been connected with the Malacological Society almost from the time of its foundation in 1893. The following year, in conjunction with another author, he contributed two papers on Chinese land shells, which were published in our 'Proceedings'. But long previous to this and afterwards he wrote many voluminous memoirs on various branches of mollusca, both fossil and recent. He gave us some of our earliest knowledge of the Tertiary mollusca of Borneo and Sumatra, and he wrote extensively on the Tertiary lacustrine shells of the Mayence Basin of Germany. He was besides one of the best authorities on fossil and recent *Clausiliæ*, and his great memoir *Clausilien-Studien*, published in 1877, still forms

a classic work in that branch of molluscan literature. He wrote also a large number of papers upon recent marine shells, but there is no doubt that his studies greatly favoured the non-marine mollusca, and on that group alone he built up a lasting reputation, and especially in connection with his researches on the family Clausiliidæ. It is only too true that this Society by the death of Professor Boettger has lost one of its most brilliant members."

He was the author of over three hundred papers, of which about one hundred and fifty treated upon recent shells and fifty upon fossil forms, altogether comprising about 3,500 pages of text, illustrated with many beautiful plates. The rest of his writings were almost exclusively upon Reptilia. What a loss to our science we have experienced through his death many of us in this country feel personally, since when in difficulty with regard to questions of determination beyond our own capabilities, Professor Boettger became our final referee, and our applications to him were invariably received with his proverbial courtesy and our difficulties solved.

E. A. S.

NOTES.

NOTE ON *MACROCHLAMYS* (*EURYCHLAMYS*) *PLATYCHLAMYS* (BLANFORD), ETC. (*Read 7th April, 1911.*)—It has been suggested that the following notes on the habits of this small mollusc, made by me in Bombay about 1898, may be of interest. The animal is of a bluish colour, the horn on the mucous pore is well marked, and the mantle has two broad shell-polishing lobes, each about a quarter of an inch long, one protruding backwards and the other forwards, over the shell.

It is most lively in very damp weather, and crawls at an astonishing pace, but if allowed to get dry, when in captivity, dies immediately. It is distinctly carnivorous; a *Succinea*, crushed by accident in its presence, was devoured on the spot.

Ariophanta bajadera (Pfeiffer), a much larger species, was attacked while crawling on my table. The *Macrochlamys* climbed into its shell and bit it savagely on the back. The *Ariophanta* got rid of its assailant by swinging its shell from side to side. On one occasion a specimen hung from my finger by a thread of mucous 3 inches long; at this point I unfortunately let him touch the ground, so did not discover how much longer he might have made his thread.

Macrochlamys pedina (Bens.), one of the commonest Bombay snails, is also carnivorous. I have seen them engaged in a cannibal feast over dead comrades crushed in the road, and have also seen one busy on the half-emptied shell of *Ariophanta lævipes* (Müll.).

I regret that I did not pursue these investigations further. Specimens of *M. platychlamys* were scarce, and I was more interested at the time in collecting good specimens of the shells than in observing the habits of the beasts.

A. J. PEILE.

PRESIDENTIAL ADDRESS.

(Delivered 10th February, 1911.)

A SKETCH OF THE CHIEF GEOLOGICAL ZONES AND THEIR MOLLUSCA.

By R. BULLEN NEWTON, F.G.S.

THE subject of my Address has been chosen with a view of placing before the Society one of the many important applications of the fossil Mollusca. In the brief history that will be submitted it will be observed that molluscan species have been frequently selected as index-fossils for the determination of certain subdivisions of the sedimentary rocks which are known as geological zones. To the ordinary student of modern Mollusca fossil shells present few features of interest, probably on account of their frequently imperfect condition or because an acquaintance with geological questions is indispensable before attempting their study or determination. The palæoconchologist, it is only too true, has often to be content with fragmentary and mineralized specimens and sometimes casts or even impressions, from a study of which he is expected to solve problems relating to the geological age of the shell or assemblage of shells, as well as to consider the many structural characters which may come under observation. Several writers have insisted upon a knowledge of the fossil Mollusca as a powerful aid in comprehending the history of existing forms, and it is pleasant in this connection to know that our former President, Mr. B. B. Woodward,¹ in his Address before the Society on "*Malacology versus Palæoconchology*", emphasized the importance of the subject as bearing upon the phylogenetic relationships of modern shells. No information on geological zones would be complete without a reference to the early work of William Smith, who was styled the "*Father of English Geology*". Smith² was the first geologist of this country to properly grasp the fact that stratified deposits followed a regular sequential arrangement, and that each layer had its distinct fossils which represented the fauna or flora at the time of deposition, and from such studies he was able to assert that strata were determinable by the organic remains which they contained.

Smith's work in this direction was an important advance on our previous knowledge, and greatly influenced palæontological studies in this country. It came to be the basis of the complicated zoning system of the rocks which at the present day has developed to almost a science in itself, with far-reaching results. The varied and abundant forms of Mollusca found in the different strata have made them valuable indices of age, many of the more characteristic having been adopted as names for certain of the geological zones now recognized.

¹ Proc. Malac. Soc. London, vol. viii, p. 66, 1908.

² *Strata Identified by Organized Fossils*, 1816.

It is necessary to understand exactly the meaning of the term 'zone' in its geological application, because some authors have regarded it as a group of "organic remains of which one abundant and characteristic form is chosen as an index",¹ in which sense the zone would be of purely zoological value; whereas it would appear from Dr. Marr's² interpretation that this term should be regarded as a geological factor, and might better be explained thus: "Zones are belts of strata, each of which is characterized by an assemblage of organic remains of which one abundant and characteristic form is chosen as an index."

Mr. Jukes-Browne,³ fully approving of Dr. Marr's views, agreed also with the general opinion that the zonal methods employed in the classification of the sedimentary rocks were merely a development of William Smith's original idea that formations could be determined by their organic contents—"Just as one stage is identified and distinguished from others by the assemblage of fossils it contains, so in its turn is the zone identified by its fossils."

Zones are frequently of wide distribution and vary much in thickness. According to Mr. H. B. Woodward⁴ "the zone of *Ammonites annulatus* in Yorkshire is some 30 feet thick, although represented in other parts of England by the thin layer known in Northamptonshire as the 'Transition Bed', which is very fossiliferous, but only a few inches thick, such a phenomenon forming a good illustration of the manner in which a bed may become attenuated in its range over distant geographical areas".

Geological zoning has mostly been attempted among the marine formations of Palæozoic and Mesozoic age, whereas the Cainozoic rocks, although often analytically classified into beds, have not yet received the same treatment of zonal classification as exemplified in the older stratified deposits.

For reference, in connection with the zones which will be now briefly described, a chart of the sedimentary formations has been introduced, which it is hoped may be of assistance to the student in comprehending the positions of the various geological horizons that will be alluded to.

PALÆOZOIC ZONES.

In the older Palæozoic rocks where molluscan remains are often obscure and sometimes difficult to determine, the index-fossils of the zones have been selected from among the more prolific organisms of other groups, such as the Trilobites (*Olenellus*, etc.), the Graptolites, or the Brachiopoda. Among Continental palæontologists, Barrande⁵ may be quoted as having published important results in connection with his examination of the Mollusca and other invertebrates found in the Lower Palæozoic deposits of Bohemia, which, although not quite

¹ H. B. Woodward, "On Geological Zones": Proc. Geol. Assoc., vol. xii, p. 298, 1892.

² *The Principles of Stratigraphical Geology*, 1898, p. 68.

³ Geological Magazine, 1899, pp. 216-19.

⁴ "On Geological Zones": Proc. Geol. Assoc., vol. xii, 1892.

⁵ *Système Silurien du Centre de la Bohême*, 1865-81 (Cephalopoda, Pteropoda, and Pelecypoda).

AN ABRIDGED TABLE OF THE STRATIFIED ROCKS.

CAINOZOIC OR TERTIARY.	Holocene . . .	<i>Alluvium, Sand, Peat Beds, etc.</i>	
	Post-Pliocene . . .	<i>Glacial, Forest Bed, Wexford Gravel, etc.</i>	
	Pliocene . . .	<i>Sicilian</i>	British Crags, Lenham Beds, etc.
		<i>Astian</i>	
		<i>Plaisancian</i>	
	Miocene . . .	<i>Pontian</i>	Unrepresented in Britain.
		<i>Sarmatian</i>	
		<i>Tortonian</i>	
		<i>Helvetian</i>	
		<i>Burdigalian</i>	
MESOZOIC OR SECONDARY.	Oligocene . . .	<i>Aquitanian</i>	
		<i>Stampian or</i>	
		<i>Rupelian</i>	Hempstead Beds (Isle of Wight).
		<i>Tongrian</i>	Bembridge, Osborne, Headon Beds, Brockenhurst, etc.
		<i>Priabonian</i>	Not present in Britain.
		<i>Bartonian</i>	Barton Beds.
	Eocene . . .	<i>Lutetian</i>	Bracklesham Beds.
		<i>Londinian</i>	London Clay.
		<i>Thanetian</i>	Thanet Sands.
		<i>Montian</i>	Not present in Britain.
		<i>Danian</i>	Various members of the 'White' Chalk formation; the Danian is not present in Britain.
	Cretaceous . . .	<i>Senonian</i>	
		<i>Turonian</i>	
		<i>Cenomanian</i>	Greensand, Chalk Marl, etc.
		<i>Albian</i>	Gault, Red Chalk, Blackdown, etc.
		<i>Aptian</i>	Hythe and Sandgate Beds, etc.
		<i>Barremian</i>	Atherfield Clay, etc.
		<i>Neocomian</i>	Speeton Clay, Tealby Beds, etc.
		<i>Wealden</i>	Hastings, Horsham, etc.
		<i>Purbeckian</i>	Dorset (Swanage), Sussex (Brightling).
		<i>Portlandian</i>	Portland, Tisbury, etc.
PALÆOZOIC OR PRIMARY.	Jurassic . . .	<i>Kimeridgian</i>	Kimeridge Clay.
		<i>Corallian</i>	Coralline Oolite, etc.
		<i>Oxfordian</i>	Oxford Clay.
		<i>Callovian</i>	Kellways Rock.
		<i>Bathonian</i>	Cornbrash, Great Oolite, etc.
		<i>Bajocian</i>	Inferior Oolite, etc.
		<i>Aalenian</i>	Midford Sands, Northampton Sands, etc.
		<i>Toarcian</i>	
		<i>Pliensbachian</i>	Liassic Series.
		<i>Sinemurian</i>	
	Triassic . . .	<i>Rhætan</i>	<i>Avicula contorta</i> zone.
		<i>Keuperian</i>	Warwickshire, etc.
		<i>Conchylian</i>	Not present in Britain.
	Permian . . .	<i>Thuringian</i>	Magnesian Limestone Series, Durham, etc.
		<i>Penjabian</i>	
		<i>Artinskian</i>	
	Carboniferous . . .	<i>Ouralian</i>	Coal-measures.
		<i>Moscovian</i>	Millstone Grit and Yoredale Beds.
		<i>Dinantian (Culm)</i>	Mountain Limestone, etc.
	Devonian . . .	<i>Condrusian</i>	Old Red Sandstone Beds of United Kingdom.
		<i>Eifelian</i>	
		<i>Coblentzian</i>	
	Silurian . . .	<i>Ludlovian</i>	Ludlow Series.
		<i>Wenlockian</i>	Wenlock and Woolhope.
		<i>Valentian</i>	Llandovery Beds.
	Ordovician . . .	<i>Caradocian</i>	Bala or Caradoc Beds.
		<i>Llandeilian</i>	Llandeilo Flags.
		<i>Arenigian</i>	Arenig, Skiddaw, Tremadoc Series.
	Cambrian . . .	<i>Olenidian</i>	Lingula Flags.
		<i>Paradoxidian</i>	Menevian Beds.
		<i>Olenellian</i>	Harlech and Longmynd Group.

on the lines of modern zoning work with its index-fossils, was nevertheless very detailed and analytical in its scope.¹

Barrande recognized that shells and other invertebrates were associated in 'colonies' or provinces, and that they could be traced over distant localities, representing, therefore, separate faunas of different marine areas. He was of opinion that there were "three distinct faunas in the Bohemian strata" below the Devonian. The first or oldest fauna he called the 'Primordial zone' or Étage C, the equivalent of the Cambrian; the second fauna was grouped as Étage D, and represented the Lower Silurian of Murchison; the third fauna included Étages E, F, G, or the Upper Silurian, as also defined by Murchison.

It is not until Carboniferous times are reached that molluscan organisms, especially in this country, appear to take a more prominent part in the history of stratification. In connection with the assemblage of shells, rather than with actual zonal forms, Dr. Wheelton Hind,² writing "On the Subdivisions of the Carboniferous Series in Great Britain", mentioned that the various Mollusca of the Yoredale rocks of Yorkshire, as originally described by John Phillips, were equivalent to those characterizing the Carboniferous Limestone of Derbyshire. In his subdivisions of the Carboniferous System Dr. Hind recognized three distinct faunas, which were tabulated in descending order as—

(1) The Coal-measure fauna, rich in fish-remains and the freshwater Pelecypod genera *Carbonicola*, *Anthracomya*, and *Naiadites*.

(2) The Lower Coal-measures and Grit fauna, the Gannister and Grit Series; largely marine, but littoral, containing *Aviculopecten* and *Posidoniella* as Pelecypod genera, *Goniatites*, *Orthoceras*, and *Nautilus* as Cephalopoda, and some peculiar Gastropoda.

(3) The Limestone fauna, essentially marine, rich in Corals, Brachiopods, and Mollusca. Many genera of Pelecypoda, such as *Pecten*, *Avicula*, *Edmondia*, *Sanguinolites*, etc., as well as Gastropoda, including *Euomphalus*, Pleurotomaroid genera, *Murchisonia*, *Loxonema*, etc., and Cephalopoda.

During the following year the same author³ proposed a slightly more analytical scheme for subdividing the Carboniferous Series of England, Scotland, and Ireland, based upon certain species of the Pelecypoda, Cephalopoda, and Brachiopoda, which he termed zones, and which may be thus enumerated:—

Zones of—

- | | |
|--|--|
| (1) <i>Anthracomya Phillipsi</i> | Upper Coal-measures. |
| (2) <i>Naiadites modiolaris</i> and <i>Anthracomya modiolaris</i> . | Middle Coal-measures. |
| (3) <i>Aviculopecten papyraceus</i> , <i>Gastrioceras carbonarium</i> , <i>Posidoniella levis</i> and <i>minor</i> . | Lower Coal-measures : Gannister Series, Millstone Grit, and Shales below Millstone Grit. |
| (4) <i>Productus giganteus</i> and <i>P. cora</i> | Carboniferous Limestone Series. |
| (5) <i>Modiola Macadami</i> | Lower Limestone Shales, Calciferous Sandstone Series, etc. |

¹ It should be mentioned that the molluscan names, as well as all horizontal terms employed in this account of the geological zones, are those of the different authors who have written upon this subject, no attempt having been made by the present writer to place them on a more up-to-date basis.

² Geological Magazine, 1897, p. 205.

³ Ibid., 1898, p. 61.

Further valuable work has been accomplished within the last few years towards more completely zoning the same series of rocks in Great Britain, but the index-fossils in connection therewith have been chosen, not from among the Mollusca, but mostly from the Brachiopoda and Corals, so that its consideration does not come within the scope of the present account.

MESOZOIC ZONES.

The Mesozoic rocks have received a large share of study in connection with their classification into zones.

First of all there is the zone of *Avicula contorta*, established by Dr. Wright in 1860,¹ characterizing the Rhætic beds, which he regarded as the equivalent of the 'Kossener Schichten' and the Upper St. Cassian strata of the Tyrol and other European districts, and consequently belonging either to the topmost series of the Triassic deposits or the basal beds of the Liassic system. The Pelecypod which gives its name to this zone was originally described by Captain Portlock² from Ireland, but the best section of the Rhætic formation is undoubtedly to be seen in the cliffs from Penarth Head to Lavernoch Point, to the south of Cardiff. It is here that the *Avicula contorta* occurs in greatest abundance, and usually in a crushed condition, making up the black shaly beds and shelly limestones of this formation, accompanied by numerous examples of *Cardium rhæticum*, in a similar state of preservation.

According to Mr. H. B. Woodward,³ the Rhætic beds are situated between the Red Marls of the Keuper Series and the Lower Lias, and extend across England from near Redcar in Yorkshire to near Lyme Regis and Axmouth on the coast of Devonshire.

For most exhaustive accounts of the *Avicula contorta* zone we are indebted to the writings of Thomas Wright⁴ and Charles Moore.⁵

In much more modern years the Trias rocks of European and Asiatic countries (India, etc.) have been carefully zoned according to the Ammonites by such authorities as Mojsisovics, Suess, Diener, and Waagen.⁶

The Liassic rocks which follow the Rhætic deposits have been specially adapted for zoning on account of the numerous Ammonites, which, commencing in the lowest beds, continue throughout the whole of the Mesozoic system. Some of the earliest remarks on this subject were made by Louis Hunton⁷ in 1838, who, studying Lias sections near Whitby, observed that "of all organic remains the Ammonoids afford the most beautiful illustration of the subdivision of strata, for they appear to have been the least able, of all the Lias genera, to conform to a change of external circumstances". He also noted the

¹ Quart. Journ. Geol. Soc., vol. xvi, p. 374, 1860.

² Report Geology Londonderry, etc., 1843, p. 126.

³ The Geology of England and Wales, 2nd ed., pp. 245, 246, 1887.

⁴ Quart. Journ. Geol. Soc., vol. xvi, p. 374, 1860.

⁵ Ibid., vol. xvii, p. 483, 1861.

⁶ Sitz. Akad. Wiss. Wien, 1895, vol. cix.

⁷ Trans. Geol. Soc. London, ser. II, vol. v, p. 215, 1838.

limited vertical range of the species of *Ammonites* and other Testacea. Similar views were held by Mr. C. Williamson¹ and published the same year, he recognizing that subdivisions of the Lias were characterized by certain species of *Ammonites*, *Belemnites*, and other Mollusca.

A few years later similar zonal work was accomplished on the Continent by Quenstedt,² with regard more especially to the German Jurassic rocks, and he was followed by Oppel³ in the same direction, his remarkable investigations extending over the Jurassic formations of England, France, and South-Western Germany. Oppel recognized the importance of the guide or index-fossil for the accurate determination of the strata without reference to lithological characters, and on this basis established a number of zones mainly on certain species of the *Ammonites*, and he determined the zone of *Ammonites raricostatus* as the highest or latest division of the Lower Lias rocks. In his account Oppel gives detailed particulars of the typical Mollusca and other invertebrates characterizing each zone, but these are not reproduced in the present notice.

Oppel's Lias zones were as follows:—

UPPER LIAS	{	Zone of <i>Ammonites Jurensis</i> .
or TOARCIEN		„ <i>Posidonomya Bronni</i> .

The chief localities for the Upper Lias zones are given as Whitby, Frocester, Ilminster, France (Caen, etc.), Germany (Boll, etc.).

MIDDLE LIAS	{	Zone of <i>Ammonites spinatus</i> .
or		„ <i>A. margaritatus</i> .
LIASIEN		„ <i>A. Davæi</i> .
		„ <i>A. ibex</i> .
		„ <i>A. Jamesoni</i> .

The chief of the Middle Lias localities are given as coast of Yorkshire, Gloucestershire, Charmouth (Dorset), France (Côte d'Or), Germany.

LOWER LIAS	{	Zone of <i>Ammonites raricostatus</i> .
or		„ <i>A. oxynotus</i> .
SINEMURIEN		„ <i>A. obtusus</i> .
		„ <i>A. tuberculatus</i> .
		„ <i>A. Bucklandi</i> .
		„ <i>A. angulatus</i> .
	„ <i>A. planorbis</i> .	

The leading localities given for the Lower Lias zones are Dorset (Lyme Regis), Somerset (Watchet), Yorkshire (Robin Hood's Bay), Gloucestershire, France (Yonne, etc.), Germany (Württemberg).

KEUPER . . Bone-bed.

Dr. Wright⁴ published in 1858 an interesting account of some Liassic fossils, mostly Mollusca, from the Scottish islands of Pabba,

¹ Trans. Geol. Soc. London, ser. II, vol. v, p. 223, 1838.

² *Das Flözgebirge Württembergs*, 1843, and *Der Jura*, 1858.

³ *Die Juraformation Englands, Frankreichs, und des südwestlichen Deutschlands*, 1856-8.

⁴ Quart. Journ. Geol. Soc., vol. xiv, p. 24, 1858.

Scalpa, and Skye, which had been collected by Sir Archibald Geikie. From an examination of these specimens he found it possible to partially zone the beds of that region, a result more or less accomplished from a comparison with the faunas characterizing the Liassic subdivisions of Swabia (Quenstedt), Würtemberg (Oppel), France (Orbigny), and Gloucestershire (Wright).

Lower Lias beds were recognized in Skye, not by Ammonite remains, but by the presence of *Cardinia concinna*, J. Sowerby, a species characterizing fairly low deposits of the Lower Lias in Würtemberg and France; *Ostrea arietis*, Quenstedt, was also determined from the same locality and beds.

The better preserved shells, however, were obtained from the 'Pabba Shales' and regarded as of Middle Lias age—

CEPHALOPODA . . .	<i>Belemnites elongatus, paxillosus, breviformis;</i> <i>Ammonites Jamesoni, brevispina, Davæi.</i>
GASTROPODA . . .	<i>Trochus imbricatus.</i>
PELECYPODA . . .	<i>Gryphæa cymbium, obliquata; Gervillia Maccullochi; Plicatula spinosa; Pecten æquivalvis; Inoceramus ventricosus; Limea acuticosta; Lima Hermannii, gigantea; Pinna folium; Mytilus cuneatus; Unicardium cardioides; Pleuromya unioides, Scottica; Pholadomya ambigua.</i>

In 1860 Dr. Thomas Wright¹ published his scheme for the subdivisions of the Lower Lias as exhibited in the South of England. He selected six species of Ammonites as his guide-fossils, and adopted Oppel's view in considering *Ammonites varicostatus* as forming the topmost zone of the series; in descending order these zones were as follows:—

Zone of <i>Ammonites varicostatus</i> .	
„	<i>A. oxynotus.</i>
„	<i>A. obtusus.</i>
„	<i>A. Turneri.</i>
„	<i>A. Bucklandi.</i>
„	<i>A. planorbis.</i>

During 1875 Professor Judd² published his memoir on the "Geology of Rutland", in which he classified into zones the various beds of the Lias of that district, founded on species of Ammonites. He took occasion to warn the student against placing too great a reliance on the zonal fossils, because, as deposits were distributed over great areas, certain gradual changes may have taken place in their faunas, so much so in fact that the index-species observed in one district may be even missing from the same stratum when occurring in another locality. Professor Judd concluded from this that zonal species are not uniformly the same over a great area, although the general assemblage of organisms presents a similar facies. This author's divisions of the

¹ Quart. Journ. Geol. Soc., vol. xvi, p. 374, 1860.

² Mem. Geol. Surv. England and Wales, 1875, p. 89.

Lias differed slightly from that of Oppel and Wright's schemes, inasmuch as he regarded *Ammonites capricornus* as the uppermost zone of the Lower Lias instead of *rivicostatus*, thus following Quenstedt's views in connexion with the Jurassic subdivisions of Germany. Professor Judd's arrangement of the Liassic zones is, however, the one adopted by the Geological Survey of this country. Its zones, in descending order, are as follows:—

UPPER LIAS . . . *Ammonites Jurensis, communis.*

MIDDLE LIAS . . . *A. spinatus, margaritatus.*

LOWER LIAS . . . *A. capricornus*(?), *ibex*(?), *Jamesoni*, *armatus*, *oxynotus*, *obtusius*, *semicostatus*, *Bucklandi*, *angulatus*, *planorbis*.

It should be mentioned here that Waagen had published a preliminary paper in 1869¹ dealing with the Ammonites and their nomenclature, in which it was suggested that the term Ammonites should no longer be applicable as a generic name, although it might be used to designate a group. He therefore divided these Cephalopods into genera and sub-genera, according to the length of the chamber occupied by the animal, the form of the mouth, the characters of the apertures when present, and the sculpture, the lobes being regarded as only of secondary importance. The names thus established were: *Ægoceras*, *Arietites*, *Amaltheus*, *Harpoceras*, *Oppelia*, *Ækotreustes*, *Stephanoceras*, *Perisphinctes*, and *Cosmoceras*.

Messrs. Tate & Blake, in their history of "The Yorkshire Lias" of 1876, recognized the following Liassic zones in that county, founded upon Ammonite species:—

	{	Zone of <i>Ammonites Jurensis</i> .
UPPER LIAS		„ <i>A. communis</i> .
		„ <i>A. serpentinus</i> .
MIDDLE LIAS	{	„ <i>A. annulatus</i> .
		„ <i>A. spinatus</i> .
		„ <i>A. margaritatus</i> .
		„ <i>A. capricornus</i> .
		„ <i>A. Jamesoni</i> .
		„ <i>A. oxynotus</i> .
LOWER LIAS	{	„ <i>A. Bucklandi</i> .
		„ <i>A. angulatus</i> .
		„ <i>A. planorbis</i> .
RHÆTIC.		<i>Avicula contorta</i> Beds.

These authors adopted the new generic nomenclature of Waagen and others for the Ammonites in the descriptive part of their work, but retained the term *Ammonites* in the generic sense for stratigraphical purposes.

Some years later Dr. Wright² published his great Monograph of the Lias Ammonites of the British Islands, in which the Lias deposits of this country were considered as corresponding to a large extent with

¹ Benecke's Paläontologische Beiträge, vol. ii, pt. ii, 1869; a fuller treatment of the same subject being published by Waagen the year following in the Paläontographica, vol. xvii, pp. 185-220, 1870.

² Paläontographica, 1878-86.

the Würtemberg Series of Germany. In this account the author gave a complete list of Lias zones, that is, including those forming the Lower, Middle, and Upper divisions of the formation, because hitherto he had only zoned the lower beds. Another innovation on this occasion was the introduction and adoption of the modern nomenclature for the Ammonites as stratigraphical index-fossils, as proposed by W. Waagen and emended by such authors as Mojsisovics, Neumayr, etc. Wright's zones were as follows:—

UPPER LIAS . .	<i>Lytoceras Jurensis</i> , <i>Stephanoceras commune</i> .
MIDDLE LIAS. .	<i>Amaltheus spinatus</i> , <i>A. margaritatus</i> , <i>Ægoceras Henleyi</i> , <i>Amaltheus ibex</i> , <i>Ægoceras Jamesoni</i> .
LOWER LIAS . .	<i>Arietites raricostatus</i> , <i>Amaltheus oxynotus</i> , <i>Arietites obtusus</i> , <i>A. Turneri</i> , <i>A. Bucklandi</i> , <i>Ægoceras angulatum</i> , <i>Æ. planorbis</i> .
RHÆTIC . . .	<i>Avicula contorta</i> .

The Inferior Oolite and later Jurassic rocks, which succeed the Liassic Series, have been subjected to much study by palæontologists for many years. Dr. Oppel,¹ however, was among the first to submit them to a systematic classification of zonal subdivisions, and, as in the case of the Lias, it was mostly on the basis of Ammonite characters, although other mollusca were adopted for this purpose, as well as Brachiopods, Echinoderms, etc. In descending order these zones may be enumerated as—

PORTLAND and	{	Zone of <i>Trigonia gibbosa</i> .
KIMERIDGE GROUP,		„ <i>Pterocera oceani</i> .
or		„ <i>Astarte supracorallina</i> .
KIMERIDGIEN		„ <i>Diceras arietina</i> .

The localities given for the Portlandian and Kimeridgian Group included the Island of Portland, Purbeck, Kimeridge, and Osmington (Dorset); Tisbury, Swindon, and Wooton Bassett (Wilts); Shotover (Oxfordshire); Aylesbury (Bucks); Hunstanton (Norfolk); Filey Bay (Yorkshire). European localities were referred to places in South-West Germany, the Swiss Jura, and France.

OXFORD GROUP {	Zone of <i>Cidaris florigemma</i> .
or OXFORDIEN {	„ <i>Ammonites biarmatus</i> .

The localities for the Oxfordien were: near Weymouth (Dorset); Wooton Bassett, Chippenham, and Calne (Wilts); Malton and Scarborough (Yorkshire). European: South-West Germany, Swiss Jura, France.

KELLOWAY GROUP {	Zone of <i>Ammonites athleta</i> .
or	„ <i>A. anceps</i> .
CALLOVIEN	„ <i>A. macrocephalus</i> .

The Callovien localities were: Scarborough (Yorkshire), Christian Malford (Wilts), Weymouth (Dorset), Lincolnshire, Kelloways (Wilts). European included areas of South-West Germany and France.

¹ *Die Juraformation England, etc.*, 1856-8.

BATH GROUP { Zone of *Terebratula lagenalis*.
or BATHONIAN { „ *T. digona*.

The Bathonian localities embraced Rushden (Northamptonshire), Stanton and Malmsbury (Wilts), Bradford and Hampton Cliff (Wilts).

BAYEUX GROUP { Zone of *Ammonites Parkinsoni*.
or „ *A. Humphresianus*.
BAJOCIAN { „ *A. Sauzei*.
„ *A. Murchisonæ*.
„ *Trigonia navis*.
„ *Ammonites torulosus*.

The Bajocian localities were: Leckhampton Hill (Gloucestershire), Dundry (Somersetshire), Scarborough and Blue Wyke (Yorkshire), Burton Bradstock (Dorset), Yeovil (Somerset), Frocester (Gloucestershire). European: South-West Germany and France.

Dr. Wright¹ succeeded Oppel in zoning the Inferior Oolite of the South of England and the Yorkshire coast, a work carried out very much upon the same lines, as he adopted the triple zonal subdivisions of that author. Wright's comparisons of these zonal faunas demonstrated a similarity of facies in each area, to prove which he furnished lists of the fossils from the zones of this series of rocks. He insisted upon the importance of specific lists, as it was only by work of this analytical character that the conclusions of the geologist and palæontologist could possibly agree, satisfactory results being only attainable "by accurate observation and a rigorous determination of the specific characters of the fossils imbedded in each superimposed stratum". Each zone was characterized by certain species of Mollusca and other invertebrates, which were special to it, and the author further emphasized the fact that there was an unequal development of the zones not only in England but also in France and Germany. He adopted Oppel's three zonal subdivisions for this series of rocks.

(1) Zone of *Ammonites Parkinsoni*: observed at Leckhampton Hill, Ravensgate Hill, Cold Comfort, Birdlip Hill, Rodborough Hill, Dundry, Bath, Yeovil, and near Bridport.

In the various beds of this zone the following Mollusca were regarded as characteristic:—

CEPHALOPODA.—*Ammonites Parkinsoni*, *Martinsi*, *Truelleri*, *subradiatus*.

GASTROPODA.—*Chemnitzia procera*.

PELECYPODA.—*Homomya gibbosa*, *Ceromya plicata*, *Trigonia signata*, *Gryphæa sublobata*, *Pholadomya Heraulti*, *Corbicella complanata*.

(2) Zone of *Ammonites Humphresianus*: present at Cleeve Hill, Dundry Hill, Gristhorpe Bay (Yorkshire), Glastonbury Tor, Yeovil, Henbury, Half-way House, Bradford Abbas.

The chief Mollusca distributed through this zone were given as—

CEPHALOPODA.—*Ammonites Humphresianus*, *Brocchi*, *Blagdeni*, *Braikenridgii*, *conceus*, *Dorsetensis*, *Sowerbyi*.

GASTROPODA.—*Chemnitzia Samanni*; *Pleurotomaria ornata*, *fasciata*, *punctata*; *Alaria Phillipsi*; *Turbo capitaneus*.

¹ Quart. Journ. Geol. Soc., vol. xvi, p. 1, 1860.

PELECYPODA.—*Lima Etheridgei*; *Pecten barbatus*; *Ostrea flabelloides, sulcifera, pyxiformis*.

(3) Zone of *Ammonites Murchisonæ*: developed at Leekhampton Hill, Crickley Hill, Beacon Hill, Frocester Hill, Wootton-under-Edge, and the Peak at Robin Hood's Bay (Yorkshire).

This zone exhibited the following leading Mollusca in its various beds:—

CEPHALOPODA.—*Ammonites Murchisonæ*.

GASTROPODA.—*Chemnitzia, Nerinea*.

Beneath the *Ammonites Murchisonæ* zone occurs the zone of *A. Jurensis*, containing at the top the so-called 'Cephalopoda Bed', with some remaining deposits below, the whole forming the 'Sands'¹ (= Cotteswold Sands, Midford Sands, etc.) which Wright grouped with the Uppermost Lias.

The chief shells of this zone were given as—

CEPHALOPODA.—*Ammonites opalinus, Jurensis, radians, insignis, variabilis*.

PELECYPODA.—*Trigonia Ramsayi*.

Since Wright's time much zonal work has been accomplished on the British Jurassic rocks by various investigators, although it is only intended in the present observations to notice the leading schemes dealing with this subject. There is, however, an important memoir by Mr. S. S. Buckman² which should be referred to, because it illustrates an entirely new feature in the subdivisions of the Jurassic Series. Mr. Buckman divided Jurassic time according to the zoological phenomena of the Ammonite fauna. He recognized two epochs, the Arietidan or earliest, which included the Ammonite families of the Arietidae and Hildoceratidae; the later epoch he called Stepheoceratidan, characterized by the families Stepheoceratidae and Opeelidae. These two epochs are further subdivided into 'ages', which latter are classified into 'hemeræ', a hemera representing a chronological unit, or in other words indicating the time during which the beds of a zone were deposited.³ In further explanation of this term it may be interesting to quote a paragraph from Mr. Buckman's⁴ memoir "On the Toarcian of Bredon Hill", which shows very definitely the author's own intention as to the meaning and scope of 'hemera'. Speaking of the approximate depths of the Toarcian deposits and their Ammonite hemeræ he remarks—"Taking, therefore, the various maxima of deposits in the South-West of England, it is seen that the work accomplished during the time of the Toarcian stage is represented by a deposition of some 700 feet of strata. The time during which this work was performed is divided

¹ See Dr. Wright's paper "On the Palæontological and Stratigraphical Relations of the so-called 'Sands' of the Inferior Oolite": Quart. Journ. Geol. Soc., vol. xii, p. 292, 1856.

² "On the Grouping of some Divisions of so-called 'Jurassic' Time": Quart. Journ. Geol. Soc., vol. liv, pp. 442-69, 1898.

³ S. S. Buckman, Geological Magazine, 1902, p. 556.

⁴ Quart. Journ. Geol. Soc., vol. lix, p. 456, 1903.

into about nine hemeræ, so that the time-value of a hemera, on this evidence, is equal to the time taken to deposit about 80 feet of strata on an average."

Briefly Mr. Buckman's scheme is as follows:—

(A) The Arietidan Epoch represents four ages, viz., Asteroceratan, Deroceratan, Harpoceratan, and Ludwigian.

The Asteroceratan Age includes a part of the Lower Lias, beginning with the zone of *Ammonites Bucklandi* and ending with the *oxynotus* zone. This age is composed of seven hemeræ in ascending order: *rotiformis*, *Gmuendensis*, *Birchi*, *Turneri*, *obtus*, *stellaris*, and *oxynoti*.

The Deroceratan Age embraces the rest of the Lower Lias and nearly all the Middle Lias, and includes seven hemeræ: *ravicostati*, *armati*, *Jamesoni*, *Valdani*, *striati*, *margaritati*, and *spinati*.

The Harpoceratan Age includes a small part of the Middle Lias and the whole of the Upper Lias; it contains ten hemeræ: *acuti*, *falciferi*, *bifrontis*, *lillie*, *variabilis*, *striatuli*, *Struckmanni*, *dispani*, *Dumortieræ*, *Moorei*.

The Ludwigian Age includes part of the Yeovil Sands and part of the Inferior Oolite; it comprises six hemeræ: *Aalensis*, *opaliniiformis*, *Scissi*, *Murchisonæ*, *Bradfordensis*, *concavi*.

(B) The Stepheoceratidan Epoch consists of two ages—Sonninian or oldest and Parkinsonian or latest. These are again subdivided into hemeræ. This epoch extends from the lower division of the Inferior Oolite to the Cornbrash of the Bathonian Series.

The Sonninian Age constitutes five hemeræ: *discitæ*, *Sonniniæ*, *Witchellie*, *Sauzei*, *Blagdeni*.

In the Parkinsonian Age is represented the following hemeræ: *Niortensis*, *garantianæ*, *Truelli*, *zigzag*, *fusca*, *subcontracti*, (maxillata), (coarctatæ), *disci*.

Complicated as Mr. Buckman's system appears, there is no doubt as to its uniqueness of detail and its far-reaching consequences, both to the geologist and the palæoconchologist. To the former it is expected to serve as a 'geological calendar', so that collectors may be able to date the species they find, whilst to the latter it is intended as an assistance in biological research, and so to advance the study of evolution. Its methods will, doubtless, have to be considered in all future classifications connected, at any rate, with the history of Jurassic rocks. The 'hemeræ' have already been adopted, and especially is this the case in Mr. L. Richardson's memoirs¹ on the "Liassic Dentaliidae", "The Inferior Oolite, etc., of the Bath-Doultong District",² and "The Inferior Oolite, etc., between Rissington and Burford".³

We will now consider the zones of the Cretaceous period, in which molluscan remains have played an important part. Taking its lower portion first, we have to recognize the analytical researches of Professor Judd, C.B.,⁴ in connection with his memoir of 1868 "On the Speeton Clay", the term 'Speeton Clay' having been founded

¹ Quart. Journ. Geol. Soc., vol. lxii, pp. 573-96, pl. xlv, 1906.

² Ibid., vol. lxiii, pp. 383-436, 1907.

³ Ibid., vol. lxiii, pp. 437-44, 1907.

⁴ Ibid., vol. xxiv, p. 218, 1868.

by John Phillips¹ during 1829 for a series of beds on the Yorkshire coast ranging from the Kimeridge Clay to the Gault. In descending order Professor Judd identified as Neocomian the following beds in the Speeton Cliff, a result mainly arrived at from a study of the Ammonites, although other molluscan species were adopted in addition for discriminating his zonal subdivisions:—

AGE OF DEPOSITS.

UPPER NEOCOMIAN
(clays and cement
beds; 150 feet).

MIDDLE NEOCOMIAN
(including zone of
Pecten cinctus and
Ancylloceras beds;
150 feet).

LOWER NEOCOMIAN
(containing zones of
Ammonites Speeton-
ensis, *A. noricus*, and
A. astierianus;
200 feet).

CHARACTERISTIC MOLLUSCA.

Cephalopoda: *Belemnites semicanaliculatus*,
Ammonites Deshayesi, *Ancylloceras* (?) *grandis*.
Pelecypoda: *Perna Mulleti*; *Exogyra*
sinuata; *Pecten elongata*, *orbicularis*; *Thetis*
Sowerbyi; *Panopæa plicata*, *neocomiensis*.
Cephalopoda: *Belemnites jaculum*; *Ammonites*;
Ancylloceras Duvali, *Emerici*. Pelecypoda:
Pecten cinctus, *Exogyra sinuata*.

Cephalopoda: *Ammonites Speetonensis*, *rotula*,
niscus, *noricus*, *marginatus*, *astierianus*, *multi-*
plicatus, *hystrix*; *Belemnites jaculum*,
lateralis; *Ancylloceras Puzosianum*, *Duvali*,
Emerici. Gastropoda: *Cerithium* sp.,
Trochus sp. Pelecypoda: *Exogyra sub-*
sinuata, *subplicata*; *Thracia Phillipsi*;
Pholadomya sp.; *Pholas constricta*.

Then follow the Jurassic beds of Portlandian, Kimeridgian, etc.

In a subsequent paper Professor Judd² showed that the Speeton Cliff beds furnished a key to the interpretation of many isolated deposits of similar age distributed over various districts of Northern Europe. On that occasion he introduced Orbigny's stratigraphical terms, and bracketed *Aptien* with his Upper Neocomian, *Urgonien* with Middle Neocomian, and *Neocomien* with Lower Neocomian.

Twenty years later Mr. Lamplugh's³ investigations "On the Subdivisions of the Speeton Clay" were published, the *Belemnites* forming the basis of classification. The term 'Middle Neocomian' used by Judd was thought to be unnecessary, since the beds which had received that name exhibited a 'Lower Neocomian' fauna, both above and below. Judd's zone of *Ammonites astierianus* was abolished in favour of the zone of *Belemnites lateralis*, which comprised a fauna showing marked Jurassic affinities, and comparable with that of the 'Upper Volga' Beds of Southern Russia, as described by Professors Pavlov⁴ and Nikitin.⁵ Lamplugh therefore regarded the zone of

¹ *Geology of Yorkshire*, 1829, p. 76.

² *Quart. Journ. Geol. Soc.*, vol. xxvi, p. 326, 1870.

³ *Ibid.*, vol. xlv, p. 575, 1889.

⁴ "Jurassique supérieur et Crétacé inférieur de la Russie et de l'Angleterre," 1889.

⁵ "Quelques excursions dans les Musées et dans les terrains Mésozoïques de l'Europe occidentale, et comparaison de leur faune avec celle de la Russie": *Bull. Soc. Belge Géol.*, vol. iii, pp. 29-58, 1889.

Belemnites lateralis as representing passage beds from Jurassic to Lower Cretaceous or Neocomian.

The zonal subdivisions and their Mollusca were as follows:—

AGE OF DEPOSITS.

[ALBIAN.]

Marls forming Zone of *Belemnites minimus* (= uppermost beds of the Speeton Clay and with affinities to the 'Red Chalk').

[APTIAN.]

Zone of *Belemnites semicanaliculatus* (?) (= *Belemnites Brunsvicensis* of Strombeck, according to Judd, see p. 611 of Lamplugh's paper).

NEOCOMIAN

(Zone of *Belemnites jaculum*).

Zone of *Belemnites lateralis*. (In this zone the author found the 'Portlandian beds' of Leckenby,¹ the fossils showing marked Jurassic affinities.)

Professor A. Pavlov and Mr. Lamplugh² contributed a joint memoir in 1892 on the "Argiles de Speeton et leurs équivalents", and subdivided the beds according to Belemnite characters as originally proposed by Mr. Lamplugh, in which the following zones and their characteristic Mollusca were given as—

ALBIAN (zone of *Belemnites minimus*). Cephalopoda: *Belemnites minimus*, *attenuatus*, *ultimus*. Pelecypoda: *Inoceramus concentricus*, *Nucula pectinata*.

CHARACTERISTIC MOLLUSCA.

Cephalopoda: *Belemnites minimus*, *attenuatus*, *ultimus*. Pelecypoda: *Inoceramus concentricus*, *sulcatus* var. (?); *Ostrea* sp.; *Avicula Rauliniana* (?); *Nucula pectinata* (?).

Cephalopoda: *Belemnites semicanaliculatus* (?), *jaculum*; *Ammonites Deshayesi*, *nucleus*; *Crioceras*; *Ancylloceras*. Gastropoda: *Rostellaria Phillipsi*, *candidula*, *bicarinata*. Pelecypoda: *Exogyra sinuata*, *Pecten orbicularis*, *Pinna tetragona*, *Cucullæa securis*, *Nucula impressa*, *Panopæa neocomiensis*, *Pholadomya Martini*.

Cephalopoda: *Belemnites jaculum*, *semicanaliculatus*; *Crioceras* (*Ancylloceras*); *Crioceras Durali*, *puzosianum*; *Ammonites marginatus*, *Speetonensis*, *astierianus*, *nucleus*, *rotula*, *noricus*. Gastropoda: *Pleurotomaria* sp.; *Trochus pulcherrimus*, *Cerithium aculeatum*. Pelecypoda: *Exogyra sinuata*, *Pecten cinctus*, *Isocardia angulata*, *Inoceramus venustulus*, *Thracia Phillipsi*.

Cephalopoda: *Belemnites lateralis*; *Ammonites noricus*, *Gravesianus*. Pelecypoda: *Avicula inæquivalvis*; *Pecten lens* var. *Morini*, *cinctus*; *Exogyra sinuata* var.; *Astarte senecta*; *Nucula* sp.

¹ "Note on the Speeton Clay of Yorkshire" (Geologist, 1859, p. 9), and in Dr. Wright's *British Fossil Cretaceous Echinodermata* (Mon. Pal. Soc., 1864, p. 9).

² Bull. Soc. Imp. Nat. Moscou, Nos. 3, 4, pls. iv–viii, xiii–xviii, pp. 181–276, 445–570, 1891.

APTIAN (zone of *Belemnites Brunsviciensis*). Cephalopoda: *Belemnites Brunsviciensis*, *Jasikowi*, *obtusirostris*; *Crioceras*. Gastropoda: *Rostellaria Parkinsoni*. Pelecypoda: *Cucullæa securis*, *Isocardia angulata*, *Nucula subangulata*, *Exogyra*.

NEOCOMIAN (zone of *Belemnites jaculum*). Cephalopoda: *Belemnites jaculum*, *Jasikowi*, *cristatus*, *subquadratus*; *Olcostephanus umbonatus*, *Decheni*, *discofalcatus*, *progrediens*, *Speetonensis*, *concinus*, *Payeri*, *inversus*, *subinversus*, *versicolor*, *Astieri*, *sulcosus*; *Crioceras*; *Ancylloceras Matheroni*; *Holcodiscus rotula*; *Hoplites regalis*, *amblygonius*, *Vaceki*, *munitus*. Gastropoda: *Rostellaria*; *Trochus pulcherrimus*. Pelecypoda: *Inoceramus venustus*; *Pecten Morini*, *cinctus*.

TRANSITIONAL BEDS BETWEEN NEOCOMIAN AND UPPERMOST JURASSIC (zone of *Belemnites lateralis*). Cephalopoda: *Belemnites lateralis*, *subquadratus*, *explanatus*, *Russiensis*; *Olcostephanus bidichotomus* cf. *Gravesi*, *Keyserlingi*, *Lamplughi*, *fragilis*; *Hoplites amblygonus*, *hystrix*, *munitus*. Pelecypoda: *Pecten cinctus*; *Exogyra sinuata*; *Astarte senecta*. Coprolite Bed — Cephalopoda: *Perisphinctes Panderi*, *Tchernyschovi*, *scythicus*, *dorsoplanus*.

UPPER KIMERIDGE. Cephalopoda: *Belemnites magnificus*; *Perisphinctes virgatus*, *Pallasi*. Pelecypoda: *Lucina minuscula*, *Ostrea gibbosa*.

The Gault deposits of the Cretaceous Series have long been studied by various investigators, their development being mostly known in South of England localities, and prominently in the neighbourhood of Folkestone (Copt Point and Eastwear Bay). To the late Mr. De Rance¹ is due the credit for having first attempted their systematic zoning at Folkestone, Ammonite species being mainly used as the index-fossils of the zones. He recognized the Continental term 'Albian' for this series of deposits, and subdivided them into eleven zones, which were grouped as 'Upper' and 'Lower Albian'. The zones with a few of their characteristic Mollusca were listed as follows:—

UPPER ALBIAN (zone of *Ammonites Goodhalli* and *A. rostratus*). Cephalopoda: *Ammonites Goodhalli*; *Belemnites ultimus*. Pelecypoda: *Pecten orbicularis*. (Zone of *Ammonites circularis* and *Kingena lima*.) Cephalopoda: *Ammonites cristatus*, *varicosus*; *Belemnites (minimus) ultimus*; *Hamites armatus*, *attenuatus*. Pelecypoda: *Nucula ovata*, *bivirgata*; *Pecten asper*. (Zone of *Nautilus Deslongchampsianus*.)

LOWER ALBIAN (zone of *Ammonites Beudanti*). Cephalopoda: *Ammonites versicostatus*. Gastropoda: *Rostellaria* allied to *pyrenaica*; *Pleurotomaria Gibbsi*. (Zone of *Ammonites auritus*.) Cephalopoda: *Hamites simplex*. Gastropoda: *Acteon affinis*; *Avellana inflata*; *Rostellaria Robinaldina*, *carinella*, *cingulata*; *Acmæa tenuicosta*; *Turbo* allied to *Yonninus*. Pelecypoda: *Pecten quinquecostatus*. (Zone of *Ammonites denarius*.) (Zone of *Nautilus Clementinus*.) Cephalopoda: *Hamites tuberculatus*,

¹ Geological Magazine, p. 163, 1868.

Sablieri. Gastropoda: *Rostellaria varicosa*; *Bellerophina minuta*. Pelecypoda: *Gervillia solenoides*. (Zone of Crustacea—*Palæocorystes*.) Gastropoda: *Turbo decussatus*; *Ampullaria lævigata*. Pelecypoda: *Pinna tetragona*. (Zone of *Ammonites auritus*, var.) Gastropoda: *Fusus iterianus*, *Scalaria Dupiniana*. Pelecypoda: *Mytilus Galliennei*. (Zone of *Ammonites Benettianus*?) The organic remains are said to be few in this zone. (Zone of *Ammonites interruptus*.) Cephalopoda: *Ammonites Deshayesi*, *dentatus*, and *Gervillianus*. The zone of *Ammonites mammillaris* at the base was regarded as belonging to the Aptian stage of the Cretaceous formation.

A few years afterwards the late Hilton Price¹ published his researches on the Folkestone Gault, based mainly on De Rance's work of 1868; in fact, with only trifling emendations he adopted the zonal classification of the beds as first suggested by that author. His work may be tabulated as follows, the characteristic Mollusca of each zone, mentioned by the author, being also included:—

UPPER GAULT (about 72 feet). (Zone of *Ammonites rostratus*.)

Cephalopoda: *Ammonites Goodhalli*, *rostratus*, *varians*. Pelecypoda: *Inoceramus Crippsi*; *Pecten Raulinianus*. (Zone of *Kingena lima*.) Cephalopoda: *Ammonites rostratus*. Pelecypoda: *Plicatula pectinoides*. Brachiopoda: *Kingena lima*. (Zone of *Ammonites varicosus*.) Cephalopoda: *Ammonites varicosus*, *rostratus*. Pelecypoda: *Inoceramus sulcatus*, *subsulcatus*.

JUNCTION BED (zone of *Ammonites cristatus*). Cephalopoda: *Ammonites Beudanti*, *cristatus*. Pelecypoda: *Pholas Sanctæcrucis*; *Mytilus Galliennei*; *Cucullæa glabra*; *Cyprina quadrata*.

LOWER GAULT (about 28 feet). (Zone of *Ammonites auritus*.)

Gastropoda: *Pteroceras bicarinatum*; *Fusus indecisus*; *Aporrhais Parkinsoni*. Pelecypoda: *Nucula bivirgata*, *ornatissima*. (Zone of *Ammonites denarius*.) Cephalopoda: *Ammonites cornutus*, *denarius*; *Turrilites Lugardianus*. (Zone of *Ammonites lautus*.) Cephalopoda: *Ammonites lautus*. Gastropoda: *Solarium moniliferum*; *Phasianella ervyna*. (Zone of *Ammonites Delaruei*.) Cephalopoda: *Ammonites Delaruei*. Gastropoda: *Natica obliqua*; *Fusus gaultinus*; *Avellana pulchella*. (Zone of Crustacea—*Palæocorystes*.) Cephalopoda: *Hamites attenuatus*. Pelecypoda: *Leda* allied to *solea*; *Pinna tetragona*. (Zone of *Ammonites auritus*, var.) Cephalopoda: *Ammonites auritus*, var. Gastropoda: *Cerithium trimonile*; *Fusus iterianus*; *Aporrhais calcarata*. Pelecypoda: *Lucina tenera*; *Corbula gaultina*; *Arca nana*; *Nucula pectinata*. (Zone of *Ammonites interruptus*.) Cephalopoda: *Ammonites interruptus*; *Crioceras astierianum*; *Hamites rotundus*.

At the base was recognized the zone of *Ammonites mammillaris* and regarded as belonging to the Lower Greensand or Upper Neocomian.

¹ Quart. Journ. Geol. Soc., vol. xxx, p. 342, 1874, and a separately published work on *The Gault*, 1879.

Dr. Barrois,¹ writing upon the age of the 'Folkestone Beds', identified the zone of *Ammonites mammillaris* as synchronous with that of the Paris Basin, which he regarded as belonging to the Gault, and therefore classed the English representative in the same formation.

The present writer in 1896² identified the zones of *Acanthoceras mammillatum* and *Hoplites interruptus* at Okeford Fitzpaine, in Dorsetshire, the former being regarded as the oldest and representing the base of the Albian (= Gault) deposits, and the latter as immediately succeeding it. A number of shells were described as being associated with the zonal forms.

The zone of *Hoplites interruptus* contained—

Cephalopoda: *Hoplites splendens*; *Nautilus Clementinus*. Gastropoda: *Acteonina formosa*; *Anchura carinata*; *Ringinella inflata*; *Natica gaultina*; *Scala Dupiniana*; *Solarium subornatum*. Pelecypoda: *Cucullæa carinata*; *Synceylonema orbicularis*; *Gervillia Forbesiana*; *Inoceramus concentricus*; *Lima parallela*; *Mytilus sub-simplex*; *Nucula pectinata*; *Exogyra canaliculata*; *Pecten Galliennei*; *Pleuromya plicata*; *Pholadomya favrina*(?); *Solen Dupinianus*; *Trigonia aliformis*, *archiaciana*, *Fittoni*.

The above Mollusca contained species occurring in similarly aged deposits at Folkestone, Black Ven, Cambridge, Blackdown, and Hunstanton (= Red Chalk beds), as well as in Continental localities.

The zone of *Acanthoceras mammillatum* contained the following shells associated with the index-form:—

Cephalopoda: *Hoplites Benettianus*. Pelecypoda: *Pleuromya plicata*; *Cucullæa carinata*; *Ostrea Leymeriei*; *Exogyra sinuata*.

This zone has been recognized at Sandgate, Folkestone, Crockerton, etc., and further localities in France, Switzerland, etc.

It may be here mentioned that an analogous fauna to that characterizing the ordinary Gault deposits of this country is found in the Blackdown³ and Haldon Beds of Devonshire, in the phosphatic 'Green-sand' of Cambridge,⁴ and in the so-called 'Red Chalk' of Norfolk,⁵ etc. (Hunstanton, etc.). Hence the whole of these strata are now generally included in the Albian stage of the Cretaceous Series.

The Chalk formation has always offered a fascinating field for study because of the many varieties of its organic remains and their unusually good preservation, causes which have contributed very largely to the exact and interesting zoning work which has been accomplished both by English and Continental palæontologists. In the different schemes that have been published from time to time on this subject, it is noticeable that the index-fossil is not so frequently

¹ Ann. Soc. Géol. Nord, vol. iii, pp. 23-5, 1876.

² R. B. Newton in Geological Magazine, 1896, p. 198; and Proc. Dorset Nat. Hist. Antiq. Field Club, vol. xviii, pp. 66-99, pls. i-iii, 1897.

³ W. Downes, Quart. Journ. Geol. Soc., vol. xxxviii, p. 75, 1882.

⁴ Jukes-Browne, *ibid.*, vol. xxxi, p. 256, 1875; vol. xxxiii, p. 485, 1877.

⁵ H. G. Seeley, Ann. Mag. Nat. Hist., ser. III, vol. vii, p. 233, 1861; T. Wiltshire, Quart. Journ. Geol. Soc., vol. xx, p. 327, 1864; Proc. Geol. Assoc. (separately published), 1859, pp. 1-18, pls. i-iv; and Quart. Journ. Geol. Soc., vol. xxv, p. 185, 1869.

withdrawn from the molluscan group as was done among the older zones of the Mesozoic rocks, from the fact that other organisms, and chiefly the Echinoids, occur much more abundantly than shells, and, moreover, are considered to possess characters which better adapt them for the subdividing of the beds.

In 1870 Caleb Evans¹ published the results of a study he had made of the Chalk sections between Croydon and Oxted in Surrey. He found that the Chalk deposits of that area were divisible into zones, similar to those which had been recognized in Northern France by Hébert,² in North-West Germany by Von Strombeck,³ in Saxony and Bohemia by Schloenbach,⁴ and in Western France by Triger.⁵ He therefore concluded that the whole of these so-called 'Chalk' beds were formed in one hydrographical area. He pointed out also that the Pelecy pod shell variously quoted as *Inoceramus mytiloides*, *labiatus*, or *problematicus* was an abundant organism of the second oldest zone of his scheme, and as commonly found in Continental areas as in this country. The index-fossils used for discriminating the zones are a combination of forms withdrawn from the Mollusca and Echinodermata. The zones were as follows:—

Zone with *Micraster coranguinum* in the upper part and *Inoceramus Cuvieri* below. = Chalk with bands of flints.

Zone with *Micraster coranguinum* in the upper part and *Ananchytes ovata* and *Spondylus spinosus* below. = Chalk with bands of flints.

Zone with *Holaster planus* and *Micraster corboris*. = Lowest beds of Chalk with bands of flint nodules.

Zone with *Inoceramus Brongniarti* and *Galerites albogalerus*, var. *subrotundus*. = White Chalk with few flints.

Zone of *Ammonites peramplus* and *Inoceramus mytiloides*. = White Chalk without flints.

Zone of *Ammonites varians* and *Belemnitella plena*. = Chalk Marl and Grey Chalk.

Writing on the "Ammonite Zones in the Isle of Thanet" during 1874, F. A. Bedwell⁶ acknowledged that Ammonites marked definite beds or "zones of life" as he expressed it. He regarded it as necessary for accurate palæontological work that collectors should obtain their fossils from properly detailed sections where separate deposits could be searched rather than from indiscriminate positions in the cliffs. The total thickness of the Chalk in the Isle of Thanet was given as 180 feet, and in this the author marked the occurrence of eighty-nine large Ammonites with an average diameter of 3 feet,

¹ "On some Sections of Chalk between Croydon and Oxted": Geol. Assoc., 1870, pp. 1-40 (separately published).

² Bull. Soc. Géol. France, ser. II, vol. xiv, p. 731, 1857; vol. xvi, p. 143, 1858; vol. xx, p. 605, 1863, etc.

³ Zeitsch. deutsch. geol. Ges., vol. xv, p. 97, 1863.

⁴ Palæontographica, vol. xiii, p. 267, 1866.

⁵ Echinoides Dép. Sarthe (Cotteau & Triger), 1855-69 (Zoologique et stratigraphique).

⁶ Proc. Geol. Assoc., vol. iii, p. 217, 1874; Geological Magazine, 1874, pp. 16, 94.

several of them being referred to *A. leptophyllus*, whilst a few were determined as *A. Lewesiensis* and one example as *A. peramplus*, all of which, it was suggested, might represent one species. The lithological features of the subject, in connection with the occurrence of a line of scattered flints, were of great importance, so much so that in more recent years Dr. Arthur Rowe¹ named it the 'Bedwell-line', regarding it as representing a zoological break in the zone of *Marsupites testudinarius*, above which, speaking generally, the Cephalopod *Actinocamax Merceyi* is always found, whilst *Ammonites leptophyllus* was restricted to a position below the line.

Mr. C. J. A. Meyer² contributed an important memoir in 1874 on the Cretaceous rocks of Beer Head in Devonshire. The Chalk cliffs of this area form the most westerly Chalk promontory of England. A general vertical section was given of the district, subdivided into twenty beds representing formations ranging from the Gault to the Upper Chalk, the Blackdown Beds being bracketed with the Gault, and the Warminster deposits regarded as equivalent to the Chloritic Marl. The whole of the beds were classified into what the author termed 'zones of fossils', the indices of which were mainly molluscan, belonging to the Cephalopoda and Pelecypoda, the remaining index-fossils being species of Echinoids, Brachiopoda, and Foraminifera. These zones were thus enumerated:—

FORMATIONS.	ZONES OF FOSSILS.
UPPER (?) CHALK. . . .	<i>Micraster coranguinum</i> .
MIDDLE CHALK	<i>Terebratula carnea</i> . <i>Inoceramus Cuvieri</i> . <i>Terebratula semiglobosa</i> .
LOWER CHALK	<i>Inoceramus Brongniarti</i> . <i>Holaster planus</i> . <i>Inoceramus mytiloides</i> . <i>Micraster corbovis</i> . <i>Rhynchonella Cuvieri</i> .
CHALK MARL	<i>Discoidea subuculus</i> . <i>Ammonites Mantelli</i> . <i>Discoidea cylindrica</i> . <i>Rhynchonella Mantelliana</i> .
CHLORITIC MARL (Warminster Beds.)	<i>Ammonites Rhotomagensis</i> <i>Scaphites æqualis</i> . <i>Holaster subglobosus</i> . <i>Catopygus carinatus</i> . <i>Rhynchonella dimidiata</i> . <i>Terebratula pectita</i> . <i>Exogyra columba</i> (var.). <i>Siphonia</i> . <i>Nautilus lævigatus</i> . <i>Discoidea subuculus</i> .

¹ Proc. Geol. Assoc., vol. xvi, p. 295, 1900.

² Quart. Journ. Geol. Soc., vol. xxx, pp. 369-93, 1874.

FORMATIONS.	ZONES OF FOSSILS.
UPPER GREENSAND . . .	<i>Orbitolina concava.</i> <i>Exogyra digitata.</i> <i>E. columba.</i> <i>Janira quadricostata.</i> <i>Pecten orbicularis.</i> <i>Exogyra conica.</i> <i>E. lævigata.</i>
GAULT	<i>Inoceramus sulcatus.</i>
(Blackdown Beds.)	<i>Exogyra conica</i> (small var.).

The classic memoir of Dr. Charles Barrois¹ on the Upper Cretaceous deposits of England and Ireland appeared in 1876. This author was of opinion that previous descriptions of the Chalk deposits of Great Britain were somewhat inadequate, and he therefore submitted a detailed account of the distribution of the beds observed in the various areas of the South of England, Norfolk, Lincolnshire, Yorkshire, and Northern Ireland. He utilized zonal subdivisions, adopting those proposed by Hébert² in his scheme of the Cretaceous deposits of the Paris Basin region of France. The faunas were also compared with those of North-West Germany; whilst the Irish Chalk he regarded as belonging to zones included in the Cenomanian, Turonian, and Senonian horizons of the Upper Cretaceous; and so resembling in this way similarly aged deposits of England.

The zones adopted by Barrois were based on five Echinoderms, one Brachiopod, and five had their index-fossils selected from the molluscan group of organisms.

	{ Zone of <i>Belemnitella mucronata.</i>
SENONIAN	{ „ <i>Marsupites ornatus.</i>
	{ „ <i>Micraster coranguinum.</i>
	{ „ <i>M. cortestudinarium.</i>
TURONIAN	{ „ <i>Holaster planus.</i>
	{ „ <i>Terebratulina gracilis.</i>
	{ „ <i>Inoceramus labiatus.</i>
	{ „ <i>Belemnites plenus.</i>
CENOMANIAN	{ „ <i>Holaster subglobosus.</i>
	{ Chloritic Marl.
	{ Zone of <i>Pecten asper.</i>
	{ „ <i>Ammonites inflatus.</i>

An excellent piece of zoning work was accomplished by Mr. Henry Woods³ some years since in connexion with the Mollusca of the 'Chalk Rock', which was a deposit so named by Mr. Whitaker,⁴ who

¹ "Recherches sur le Terrain Crétacé supérieur de l'Angleterre et de l'Irlande": Mém. Soc. géol. Nord [Lille], 1876, pp. 234, maps and sections. Ann. Soc. géol. Nord [Lille], vol. iii, p. 190, 1876.

² Bull. Soc. géol. France, published mostly in the seventies.

³ Quart. Journ. Geol. Soc., vol. lii, pls. ii-iv, pp. 68-98, 1896; vol. liii, pls. xxvii-xxviii, pp. 377-404, 1897.

⁴ Catalogue of Rock-specimens in the Museum of Practical Geology, 2nd ed., p. 296, 1860; Quart. Journ. Geol. Soc., vol. xvii, p. 166, 1861.

considered it to be the topmost bed of the Lower Chalk. Mr. Woods, however, regarded it as occurring at the top of the Middle Chalk, that is, succeeding the zone of *Holaster planus* and followed by the zone of *Micraster cortestudinarium*. The Chalk Rock fauna was recognized as being distributed over Berkshire, Oxfordshire, Buckinghamshire, Wiltshire, Hertfordshire, Kent, Cambridgeshire, and Hampshire, being known also on the Continent—France, Germany, etc. As in North-Western Germany (Westphalia, etc.), this Chalk bed represents the zone of *Heteroceras Reussianum*, so Mr. Woods suggested the adoption of that name for the zone of the 'Chalk Rock' as it occurs in this country. The Mollusca described and figured in this work comprised Cephalopoda, Gastropoda, Scaphopoda, and Pelecypoda. Instructive tables were given showing the distribution of the species throughout the various zones of England, Ireland, and European areas. The author considered that the fauna presented a Turonian facies, and he also regarded it as of a comparatively shallow-water character.

In 1889 Mr. Jukes-Browne¹ formulated a zonal scheme for the British Chalk formation, which resembled that of Barrois in its main divisions, although fewer Mollusca were used for the index-fossils—

UPPER CHALK	{	Zone of <i>Marsupites</i> .
		„ <i>Micraster coranguinum</i> .
		„ <i>M. cortestudinarium</i> .
		Chalk Rock.
MIDDLE CHALK	{	Zone of <i>Holaster planus</i> .
		„ <i>Terebratulina gracilis</i> .
		„ <i>Rhynchonella Cuvieri</i> .
		Melbourn Rock at base.
LOWER CHALK	{	Zone of <i>Belemnitella plena</i> .
		„ <i>Holaster subglobosus</i> , with Totternhoe Stone at base.
		„ <i>Ammonites varians</i> .

Another scheme was proposed by Mr. Jukes-Browne² in 1903 for subdividing the Lower and Middle Chalk of England into zones, which differed from that of 1889, as each division was formed of two zones instead of three. These, with their characteristic Mollusca, were as follows:—

MIDDLE CHALK (zone of *Terebratulina gracilis*, var. *lata*). Cephalopoda: *Prionotropis Woolgari*; *Pachydiscus peramplus*; *Haploceras peramplus*. Pelecypoda: *Inoceramus Cuvieri*; *Spondylus spinosus*. (Zone of *Rhynchonella Cuvieri*.) Cephalopoda: *Acanthoceras nodosoides*. Pelecypoda: *Inoceramus mytiloides*.

LOWER CHALK (zone of *Holaster subglobosus*). Cephalopoda: *Acanthoceras navicularis*, *rotomagensis*; *Haploceras Austeni*; *Actinocamax plenus*. (Zone of *Ammonites varians*.) Cephalopoda:

¹ In W. Whitaker's *The Geology of London* (Mem. Geol. Surv. England and Wales), vol. i, p. 58, 1889.

² *Cretaceous Rocks of Britain: The Lower and Middle Chalk of England* (Mem. Geol. Surv. United Kingdom), 1903, p. 558.

Schlenbachia varians; *Acanthoceras Mantelli*, *rotomagensis*; *Scaphites equalis*. Pelecypoda: *Inoceramus latus*; *Aucellina gryphæoides*.

The British Upper Chalk beds were finally classified for the Geological Survey by Mr. Jukes-Browne¹ in 1904, in which the zone of *Holaster planus* was recognized as the base, which differed from his views of 1889, when it was regarded as the topmost zone of the Middle Chalk (or Turonian), this latter being the position generally acknowledged by all authorities on the Chalk zones.

A new zone was established on this occasion for the Chalk deposits near Trimingham and Mundesley on the Norfolk coast, regarded as the highest Chalk of England, which was termed the zone of *Ostrea lunata*, its position being just above the *Belemnitella mucronata* zone. The new scheme of zones was as follows:—

ZONES.

CHARACTERISTIC MOLLUSCA.

<i>Ostrea lunata</i>	Pelecypoda: <i>Ostrea lunata</i> ; <i>Pecten serratus</i> .
<i>Belemnitella mucronata</i> . . .	Cephalopoda: <i>Belemnitella mucronata</i> , <i>lanceolata</i> .
<i>Actinocamax quadratus</i> . .	Cephalopoda: <i>Actinocamax quadratus</i> , <i>Belemnitella lanceolata</i> .
<i>Marsupites testudinarius</i> . .	Cephalopoda: <i>Ammonites leptophyllus</i> ; <i>Actinocamax verus</i> , <i>granulatus</i> .
<i>Micraster coranguinum</i> . .	Cephalopoda: <i>Actinocamax verus</i> . Pelecypoda: <i>Inoceramus involutus</i> .
<i>Micraster cortestudinarium</i> .	[No characteristic Mollusca are given.]
<i>Holaster planus</i>	Cephalopoda: <i>Heteroceras Reussianum</i> ; <i>Scaphites Geinitzi</i> ; <i>Pachydiscus peramplus</i> . Gastropoda: <i>Trochus Schlüteri</i> ; <i>Solariella gemmata</i> .

Following this, it is important to mention that Mr. R. M. Brydone,² who had studied the Trimingham Chalk of Norfolk, published, in 1906, his observations on this subject. He objected to the “zone of *Ostrea lunata*”, established by Mr. Jukes-Browne for the Chalk beds of this locality above the *Belemnitella mucronata* zone, because that fossil, although abundantly represented, did not occur throughout the whole of the zone; he therefore suggested naming it “the zone of *Terebratulina gracilis* and *T. Gisei*”, as those forms of Brachiopods were found in³ all its beds. In a subsequent paper on the same subject Mr. Brydone again called in question the zone of *Ostrea lunata*, and apparently forgetting that two years previously he had suggested another zonal name to take its place, stated that “hence the zone of Chalk at Trimingham, lying above the zone of *Belemnitella mucronata*, now divided and defined by me for the first time, requires a name”.

¹ *Cretaceous Rocks of Britain: The Upper Chalk* (Mem. Geol. Surv. United Kingdom), 1904, p. 5.

² *Geological Magazine*, 1906, p. 15.

³ *Quart. Journ. Geol. Soc.*, vol. lxiv, p. 410, 1908.

The latest and most exhaustive researches on the British Chalk are undoubtedly those made by Dr. Arthur W. Rowe¹ in a series of memoirs on "The Zones of the White Chalk of the English Coast", published between 1900 and 1908, the maps to which were constructed by Mr. C. Davies Sherborn. From long and careful collecting, the author plans out the zonal distribution of fossils in the coastal white chalk deposits of England, as observed in Kent, Sussex, the Isle of Wight, Dorset, Devonshire, and Yorkshire.

He divided these deposits into seven zones, but the only mollusc used as an index-fossil was that of the Cephalopod *Actinocamax quadratus*, which is regarded as characterizing the latest or newest zone of the series, the remainder being Echinoderms and Brachiopods. The distribution of the various species of the Mollusca is, however, most minutely treated, and by a system of tables the zonal position of any form can be immediately ascertained, this same remark applying to the other members of the invertebrate groups of zoology.

The arrangement of these zones and their characteristic Mollusca are given as follows:—

SENONIAN (zone of *Actinocamax quadratus*). Cephalopoda: *Actinocamax quadratus*, *granulatus* (*Merceyi*); *Hamites*; *Scaphites inflatus*. Pelecypoda: *Inoceramus lingua*; *Ostrea Wegmanniana*; *Avicula tenuicostata*. (Zone of *Marsupites testudinarius*.) Cephalopoda: *Actinocamax granulatus*, *verus*; *Ammonites leptophyllus*. Pelecypoda: *Ostrea vesicularis*, *Wegmanniana*. (Zone of *Micraster coranguinum*.) Cephalopoda: *Actinocamax granulatus*, *westfalicus*. Pelecypoda: *Inoceramus Cuvieri*, *involutus*. (Zone of *Micraster cortestudinarium*.) Pelecypoda: *Plicatula Barroisi*; *Inoceramus Lamarcki*.

TURONIAN (zone of *Holaster planus*). Gastropoda: *Pleurotomaria perspectiva*; *Turbo gemmatus*. Pelecypoda: *Inoceramus Lamarcki*, *Brongniarti*; *Plicatula Barroisi*; *Ostrea proboscidea*. (Zone of *Terebratulina gracilis*.) Cephalopoda: *Ammonites peramplius*. Pelecypoda: *Inoceramus labiatus*, *Brongniarti*, *Lamarcki*; *Spondylus spinosus*; *Ostrea vesicularis*. (Zone of *Rhynchonella Cuvieri*.) Cephalopoda: *Ammonites Cunningtoni*, *peramplius*. Pelecypoda: *Inoceramus labiatus*, *Lamarcki*; *Ostrea vesicularis*.

In concluding my résumé of the geological zones it is almost needless to remark that due attention to such a subject is a necessary adjunct to accuracy of collecting, and all studies in this direction must lead to satisfactory results. No longer is the palæontologist contented with acquiring his specimens indiscriminately from a quarry or a section, but he is careful to obtain them from each separate bed, so that he may become acquainted with individual faunas, the organisms of which will often present interesting points of variation and change, and so form the basis of inquiries connected with the evolution of genera and species.

¹ Proc. Geol. Assoc., vol. xvi, pp. 289-368 (Kent and Sussex), 1900; vol. xvii, pp. 1-76 (Dorset), 1901; vol. xviii, pp. 1-51 (Devon), 1903; vol. xviii, pp. 193-296 (Yorkshire), 1904; vol. xx, pp. 209-352 (Isle of Wight), 1908.

It is among the Mesozoic rocks that zonal work has been so largely and successfully accomplished ; and speaking of quite modern years there is no doubt that the investigations of Mr. S. S. Buckman on the Jurassics and of Dr. Rowe on the Upper Cretaceous have done much to direct attention to the great value of this form of research, besides inspiring the collector with a greater zeal for his field-work. Since the publication of Dr. Rowe's first memoir on the Coastal Upper Chalk of this country in 1900, a number of observers have shown their interest in certain local developments of the Chalk and their zones, and the issue of many important papers has been the direct result ; although such works are not referred to on this occasion they are of great value as forming part of the history of zonal geology.

ON THE RECENT SPECIES OF THE GENUS *VULSELLA*.¹

By EDGAR A. SMITH, I.S.O.

Read 10th March, 1911.

PLATE XI.

HAVING recently had occasion to identify a specimen of this genus from the Natal coast it became necessary to study the group as a whole and to examine the literature of the subject, more particularly the reviews of the genus by the Marquis A. de Gregorio (Bull. Soc. Malac. Ital., vol. x, pp. 49-72, 1884) and A. H. Cooke (Annals and Magazine of Natural History, vol. xvii, pp. 59-67, 1886). In the first place it seemed imperative to determine with certainty the six recent species included in the genus by Lamarck, who was the first to characterize it. For this purpose I applied to the Paris Museum for loan of some of the Lamarckian specimens, and through the kindness of Professor Germain I have had an opportunity of studying *Vulsella lingulata*, *spongiarum*, *mytilina*, and *ovata*.

The two other species, *V. hians* and *V. rugosa*, were described by Lamarck from specimens in his own collection, now in the Geneva Museum. On applying to that institution for drawings of these, Dr. E. F. Weber very kindly had excellent photographs taken of each, and also had coloured drawings made. I beg to express my thanks to him for so kindly acceding to my request. With the aid of the actual specimens from Paris and these photographs I am now in a position to recognize the Lamarckian species, which otherwise would have been impossible from the original inadequate descriptions. I also wish to express my sincere thanks to the Marquis A. de Gregorio for sending me in a most friendly manner the material described in his work.

The recent species of *Vulsella* have been listed or monographed several times.

1798. Bolten (Mus. Bolt., p. 156) quoted two species, *V. major* and *V. minor*, the former being the same as the *Mya vulsella* of Linnæus.

1819. Lamarck, Hist. Anim. sans Vert., vol. vi (1), pp. 220-2. Six species described: *V. lingulata*, *hians*, *mytilina*, *rugosa*, *spongiarum*, and *ovata*.

1858. Reeve, Conch. Icon., vol. xi, spp. 1-17, pls. i, ii. In addition to the Lamarckian species eleven additional names were proposed: *V. attenuata*, *trita*, *corollata*, *lingua-felis*, *phasianoptera*, *isocardia*, *crenulata*, *pholadiformis*, *rudis*, *limæformis*, and *Tasmanica*. In my opinion only one of these is retainable as a distinct species, namely *V. attenuata*.

1864. Munier-Chalmas, Bull. Soc. Linn. Normandie, vol. viii, pp. 97-110.

A list, without any comments, including the six Lamarckian and eleven Reevian species, also *minor*, Chemnitz.

1874. Dunker, Jahrb. deutsch. Malak. Ges., vol. ii, pp. 1-3.

¹ Published by permission of the Trustees of the British Museum.

Three species admitted, viz., *V. lingulata*, Lamk.; *minor*, Chemn.; and *hians*, Lamk.

1884. De Gregorio, Bull. Soc. Mal. Ital., vol. x, pp. 49-72, pls. i-v; vol. xi, pp. 120-2. In addition to the already named so-called species, the author has here invented twenty-one names for supposed distinct forms. Nearly all of these are, I consider, mere mutations, and hardly that, of *V. rugosa* of Lamarek.

1886. Cooke, Ann. Mag. Nat. Hist., vol. xvii, pp. 59-67. No new forms described. A criticism of the species described by Reeve and by Lamarek, the latter of which he had never seen. The works of Bolten, Munier-Chalmas, Dunker, and de Gregorio appear to have been *unknown* to Mr. Cooke! *V. Nuttalli* of Conrad included in his list belongs to the genus *Malleus*.

1890. Clessin, Küster's Conch. Cab., Malleacea, pp. 16-25, pls. v-vii. This monograph is a very poor production, founded mainly on Reeve's work, and most crudely illustrated, the figures in many cases being merely bad reproductions of those in the *Conchologia Iconica*.

After carefully studying the works mentioned, and the collections at my disposal, I am of opinion that four species are retainable, namely, *V. vulsellæ*, *V. attenuata*, *V. rugosa*, and *V. spongiarum*. I do not agree with Mr. Cooke in the manner in which he has referred some of Reeve's specimens to these; for instance, *crenulata*, *isocardia*, *dilatata*, *lingua-felis*, part, and "*rugosa*, Reeve (non Lam.)", I place under *V. rugosa* and not under *spongiarum*. Also *V. trita*, Reeve, is certainly only a stunted *V. vulsellæ*, and not *V. spongiarum*.

The work of de Gregorio has made the study of this genus hopeless for those who cannot have his types for examination. I regard his paper as descriptive of individual specimens only, often in bad, dead condition, or young shells. Then there is the uncertainty of their habitat. Although the author was assured by the seller of the sponges from which they were extracted that they were Mediterranean, it seems almost certain that they came from the Red Sea.

Genus *VULSELLA*, Bolten.

1. *VULSELLA VULSELLA* (Linn.).

Mya vulsellæ, Linn., Syst. Nat., 10th ed., p. 671, 1758; 12th ed., p. 1113; Gmelin, vol. vi, p. 3219.

Vulsella vulsellæ, de Gregorio, Bull. Soc. Mal. Ital., vol. x, p. 66, pl. v, figs. 1-1c.

V. major, Bolten, Mus. Bolt., 1798, p. 156.

V. lingulata, Lamarek, Anim. s. Vert., vol. vi, p. 221, 1819; Encycl. Méthod., pl. 178, fig. 4; Reeve, Conch. Icon., vol. xi, fig. 6; Adams, Genera Moll., pl. cxxii, figs. 4, 4a; Clessin, Conch. Cab., Malleacea, pl. v, fig. 4; Dunker, Jahrb. deutsch. Malak. Ges., 1875, p. 2; Vaillant, L'Institut, No. 1645, p. 222, 1865; Comptes Rendus, vol. lxvi, pp. 1122-5, 1868; Ann. Sci.

- Nat., vol. ix, pp. 281-310, pl. xii, 1868, anatomy; Menegaux, *Recherches Circulation Lamellib.*, 1890, pp. 44-8, figs. anatomy.
V. mytilina, Lamarck, op. cit., p. 268, abnormal; Reeve, fig. 4, worn and faded specimen; Clessin, pl. vi, fig. 6.
V. hians, Lamarck, op. cit., p. 221.
V. trita, Reeve, op. cit., fig. 17, worn and stunted shell; Clessin, pl. vii, fig. 7, after Reeve.

Hab.—Red Sea, Madagascar, Tranquebar, Singapore, North Borneo, Philippines, Japan, North Australia, New Caledonia.

Dunker¹ has already suggested that *V. mytilina* is a form of *lingulata*, at least he considered the shell figured by Reeve a worn abnormal specimen of it. Having now seen the very large shell named by Lamarck *mytilina* (Pl. XI, Fig. 1) and also that figured by Reeve under that name, I quite agree with Dunker in his decision. Lamarck described his shell as 'alba', which it certainly is not. It is of a livid tint, and exhibits in places quite distinct brown lines like those which are so characteristic of *V. vulsellæ*. In the shell figured by Reeve these lines are also observable, although no mention of them is made by that author. I do not think Chemnitz's figures (Conch. Cab., vol. vi, pl. ii, figs. 8, 9) which Mr. Cooke places in the synonymy of *mytilina* have anything to do with it, nor can I agree with his statement respecting the want of colouring in Reeve's specimen of *mytilina*, for, as I have already stated, the brown lines are quite discernible.

V. trita, Reeve (fig. 17), is probably a stunted or half-grown specimen of *V. vulsellæ* in a dreadfully worn condition, having only a trace of brown lineations at the lower margin. I cannot associate it with *V. spongiarum* as Mr. Cooke has done. Its condition, however, is so bad that it is hardly possible to determine with any degree of certainty to what species it really belongs. Well may Mr. Cooke observe, "only those who have seen the type of this shell can realize to what depth species-makers can descend." He might also have made the same remark respecting *pholadiformis*, Reeve. Since the above was written I have obtained specimens in good condition from Messrs. Sowerby and Fulton which prove beyond a doubt that *V. trita* is only a young stage of the present species.

The photographs and drawing of Lamarck's type of *V. hians* (Pl. XI, Figs. 2, 3) clearly show that it is a short example of *V. vulsellæ*. The character of the lineation and the fine granose sculpture are precisely the same as in the typical elongate form, and the non-divergent umbones are also characteristic. Reeve (Conch. Icon., fig. 16) has figured a form *V. rugosa* as *V. hians*.

In his review of this genus the Rev. A. H. Cooke² has made a most remarkable mistake in connection with *V. vulsellæ*, the present species. How such an error could have been committed it is difficult to conceive. He has given a rough translation of Rumphius's observations on the habitat of an *Ostrea* attached to stems of mangrove, being under

¹ Jahrb. deutsch. Malak. Ges., vol. ii, p. 2, 1875.

² Ann. Mag. Nat. Hist., vol. xvii, p. 63, 1886.

the impression that it referred to the present species. *V. vulsellæ* is badly figured by Rumphius on his pl. xlvii, fig. A, and the description quoted by Cooke refers to pl. xlvii, fig. A. The account given by Rumphius so obviously applies to one of the forms of oysters, such as *Ostrea folium*, that it is inconceivable how it could be supposed in any way to refer to *Vulsellæ*.

2. *VULSELLA ATTENUATA*, Reeve.

? *Vulsellæ minor*, Bolten, Mus. Bolt., p. 156, founded on Chemnitz, Conch. Cab., vol. vi, p. 23, pl. ii, figs. 8, 9.

V. attenuata, Reeve, Conch. Icon., vol. xi, fig. 5; Clessin, Conch. Cab., Malleacea, pl. v, figs. 1, 2.

V. spongiarum, Reeve (*non* Lamarck), fig. 15; Clessin, pl. v, fig. 3, after Reeve.

V. ililima, de Gregorio, Bull. Soc. Mal. Ital., vol. x, p. 69, pl. v, fig. 5.

V. Assabensis, de Gregorio, op. cit., vol. xi, p. 121.

V. pholadiformis, Reeve, op. cit., fig. 1, a young abnormality probably; Clessin, pl. vii, fig. 8, copy of Reeve.

Hab.—Red Sea, Suez, Gimsah, Assab; also at Tongaat, Port Shepstone, Alexandra Junction, and Umkomaas, all in Natal (H. Burnup).

This species is smaller than *V. vulsellæ*, and has the umbones divergent, so that there is a deep triangular ligamental fossa visible in each valve. The anterior margin of the valves, towards which the umbones incline, is prominent. This feature is shown in Reeve's figs. 15, 1, 5. Although the general form of the shell is variable there is a tendency in most adult specimens to attenuation or narrowing posteriorly. Young shells are short and ovate, but soon begin to lengthen as they increase with age. In the brown lineation and sculpture the species is rather like *V. vulsellæ*. The description of the hinge given by Chemnitz of his "*Mya vulsellæ minor*" (*Vulsellæ minor*, Bolten) applies well to that of the present species, and his specimens were said to have come from the Red Sea. It is therefore quite possible that they belonged to the present species, although no mention is made of radiating colour-markings.

A small example of this species with abnormally divergent umbones and very large ligamental areas to the valves was wrongly determined as *V. vulsellæ* (Smith, Ann. Natal Mus., vol. ii, pt. ii, p. 213). At the time I did not sufficiently estimate the specific value of the divergent umbones and hinge-area.

3. *VULSELLA RUGOSA*, Lamarck. Pl. XI, Figs. 6, 7.

Vulsellæ rugosa, Lamarck, Anim. s. Vert., vol. vi, p. 222; Delessert, Recueil, pl. xviii, figs. 3a-c; Reeve, Conch. Icon., vol. xi, figs. 7, 8, dark var.; de Gregorio, Bull. Soc. Mal. Ital., vol. x, p. 69, pl. v, fig. 2; Clessin, Conch. Cab., pl. vii, fig. 1, copy of Reeve; fig. 6 as *limæformis*, Reeve, which it is not.

V. margaritacea, Risso, Hist. Nat. Europe Mériid., vol. iv, p. 307, pl. xii, fig. 168, probably.

V. corollata, Reeve, op. cit., fig. 14; Clessin, pl. vi, figs. 4, 5.

- V. lingua-felis*, Reeve, part, fig. 13a; Clessin, pl. vii, figs. 2, 3.
V. phasianoptera, Reeve, fig. 11; Clessin, fig. 5, copy of Reeve.
V. isocardia, Reeve, fig. 2; Clessin, pl. vii, fig. 5, copy of Reeve.
V. hians, Reeve (*non* Lamarck), fig. 16; Clessin, pl. vi, fig. 3, copy of Reeve.
V. crenulata, Reeve, fig. 9; Clessin, pl. vi, figs. 1, 2.
V. Hügeli (Parreiss MSS.), Küster, Conch. Cab., Malleacea, p. 16, not figured, 1841.
V. peregrina, *indipa*, *navicula*, *claripta*, *tigrina*, *ringella*, *pulchella*, *scrobula*, *umbotropa*, *cochlearina*, *virginis*, *cilestrina*, *mirula*, *umbo-versa*, *mitis*, *blanda*, *spongiarum* (*non* Lamarck), *valida*, *vuma*, *cimbula*, and *caramagnæ*, all described and figured by de Gregorio, Bull. Soc. Mal. Ital., vol. x, pp. 58–70, pls. i–v; vol. xi, p. 121.
Reniella dilatata, Swainson (?), Malacology, p. 386, fig. 127, 1840, unrecognizable.

Hab.—Red Sea, Aden, Zanzibar, Mauritius, Maldives Islands, Singapore. These localities are probably all reliable. Australia and Philippines respectively for *phasianoptera*, Reeve, *Hügeli*, Küster, and *hians*, Reeve (*non* Lamarck), are more or less uncertain.

The majority of the forms named and described by de Gregorio were supposed to have been extracted from sponges from the Tunisian coast, but it seems very doubtful whether they really occur in the Mediterranean, and the Marchesa di Monterosato¹ has already expressed his doubts upon the matter. He suggests that they were all derived from Red Sea sponges, which seems most probable, as *Vulsella* had never before been recognized as a Mediterranean genus, with the exception of Risso's account of *V. margaritacea*, supposed (but evidently erroneously) to occur on the shores of the Alpes Maritimes. The genus also is not known from any of the Mediterranean post-Pliocene deposits which one would have expected if the recent forms really occurred in that sea.

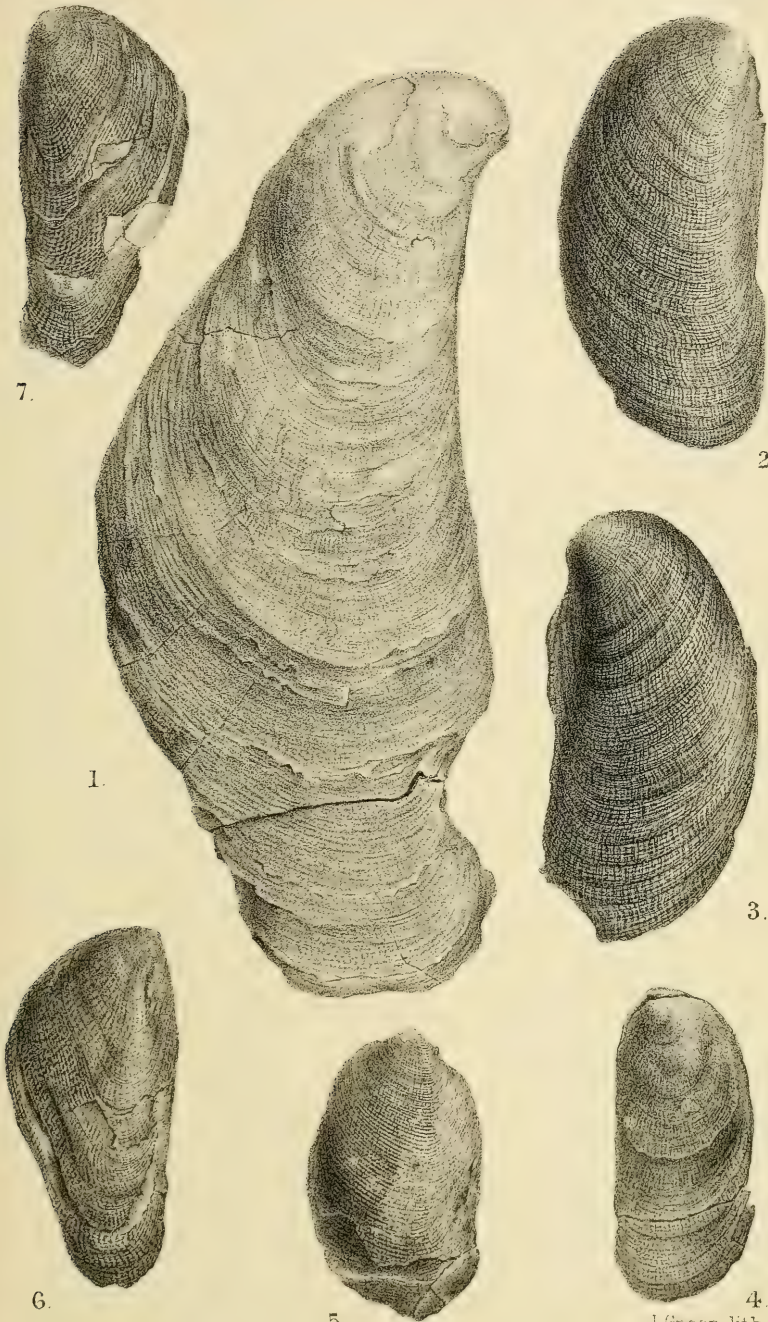
It would be useless to discuss individually the species or forms described by de Gregorio, as only an examination of the types themselves can show their features and value. I may say, however, it is most astonishing that in some cases (e.g. *tigrina*, *scrobula*, *umbotropa*, *virginea*, *blanda*, etc.) such dead, worn, or young shells should have been described as distinct.

V. rugosa never occurs as large as the adult *V. vulsella*, in which species the sculpture seems to be finer, that is, the wavy longitudinal rows of scales are more numerous, and the brown lineations are finer and often darker in tint. The umbones in some specimens of *V. rugosa* are slightly divergent, but not so strongly as in *attenuata*. A whitish variety of *V. rugosa* without any trace of colour-markings occurs at the Mauritius.

A series of specimens collected at Aden by Major Yerbury were recorded as *V. vulsella* (Smith, Proc. Zool. Soc., 1891, p. 434). These are typical examples of *V. rugosa*.

Two specimens of *V. Hügeli*, purchased by the Museum from

¹ *Nomenclatura Conch. Mediter.*, 1884, p. 7.



J. Green lith.

THE TYPES OF LAMARCK'S RECENT SPECIES OF VULSELLA.

Herr Parreiss in 1841, are rather dark-coloured forms of the present species, and are quite distinct from *V. spongiarum*, to which they were supposed by Mr. Cooke to belong.

4. *VULSELLA SPONGIARUM*, Lamarck. Pl. XI, Fig. 4.

?*Vulsella minor*, Bolten, Mus. Bolt., p. 156, 1798; Dunker, Jahrb. deutsch. Malak. Ges., vol. ii, p. 2, 1875.

V. spongiarum, Lamarck, Anim. s. Vert., vol. vi, p. 222; Cooke, Ann. Mag. Nat. Hist., vol. xvii, p. 65, 1886.

V. lingua-felis, Reeve, part, Conch. Icon., fig. 13b.

V. rudis, Reeve, op. cit., fig. 12.

V. limæformis, Reeve, figs. 10a, b.

V. Tasmanica, Reeve, fig. 3; Clessin, Conch. Cab., pl. vii, fig. 4 (bad copy of Reeve's crude figure).

Var. = *V. ovata*, Lamarck, op. cit., p. 222; Cooke, op. cit., p. 66.

Hab.—Tasmania, South Australia, Swan River (Brit. Mus.). It appears to be confined to Australia.

The striking feature of this species is the absence of radiating colour-lines which occur in *V. vulsellæ*, *V. attenuata*, and *V. rugosa*. The shells are mostly brownish or livid brown, sometimes pale towards the umbones and at the sides of the valves. The squamose radiating sculpture is finer and closer in this species than in *rugosa*.

Mr. Cooke has associated with this species *V. pholadiformis*, *isocardia*, *crenulata*, *lingua-felis*, and *trita* of Reeve, *dilatata* Swainson, and *Hügelii* Küster, but all of these, excepting *pholadiformis* and *trita*, I regard as forms of *V. rugosa*. They all have the lineation of that species and the coarser radiating sculpture.

Although the types of *V. spongiarum* and *V. ovata* are so different in form, a large series of specimens seems to connect them. Lamarck's descriptions of these two species are so brief as to be of no use for modern purposes. In describing *spongiarum* the sculpture is said to consist of transverse concentric rugæ, with obsolete longitudinals. I presume the former are the concentric lines of growth, which, in the rather worn shells he had before him, are to the unassisted eye fairly well marked at intervals. Although the longitudinal sculpture is said to be obsolete it is quite discernible under a lens, and forms on crossing the concentric striæ a finely squamate surface.

The sculpture of *ovata* is quite of the same character, but much more distinct in the unique shell described by Lamarck, which is in a very fresh and unworn condition. The concentric lines of growth are especially evident, and, as in *spongiarum*, are squamose through being cut across by the radiating sculpture. Of the latter there is very little at the sides, and it is principally down the central area of the valves that it occurs.

The type of *ovata* (Pl. XI, Fig. 5) is an exceptionally dark-coloured specimen, described by the author as "subviolacea". I should rather call it purplish brown, pale at the sides towards the umbones. The interior of the valves is also for the greater part dark purplish, the sides, of course, like the exterior, being pale. The specimens of *V. spongiarum* are not so dark-coloured. They

are dirty whitish stained with purplish brown, but not of so dark a tint as *V. ovata*.

In his account of *V. spongiarum*, Lamarck questioned the identity of that species with the *Mya vulsella minor* of Chemnitz (= *V. minor*, Bolten), but I am inclined to agree with Dunker in considering them the same. Still, there is some uncertainty. Chemnitz makes no reference to radiating lineation, and his description "schmutzig weissgelblich" of the colour and his figures also apply to the present species. His specimens were said to have come from the Red Sea, and if such were really the case, it then seems probable that they may have been the *V. attenuata* of Reeve.

Messrs. Pritchard & Gatliff¹ have united the present South Australian species to *V. vulsella*. It is, however, a very distinct shell, and never attains the size of *V. vulsella* (= *lingulata*, Lamk.) and has no radiating colour-lines.

EXPLANATION OF PLATE XI.

- FIG. 1. *Vulsella mytilina*, Lamk. (type) = *V. vulsella*, var.
 „ 2, 3. *V. hians*, Lamk. (type) = *V. vulsella*, var.
 „ 4. *V. spongiarum*, Lamk. (type).
 „ 5. *V. ovata*, Lamk. (type) = *V. spongiarum*, var.
 „ 6, 7. *V. rugosa*, Lamk. (type).

¹ Proc. R. Soc. Victoria, N.S., vol. xvii, p. 257, 1904.

ON A NEW SPECIES OF *PHASIANELLA* FROM SOUTH AFRICA.

By EDGAR A. SMITH, I.S.O.

Read 10th March, 1911.

FIVE species of *Phasianella* are known from South Africa—*Kochii*, Philippi, *elongata*, Krauss, *Capensis*, Dunker, *bicarinata*, Dunker, and *neritina*, Dunker. Krauss has also quoted *tenuis*, Philippi, a Mediterranean form.

P. Capensis, *bicarinata*, and *neritina* are easily distinguishable, but there is much difficulty in drawing a line of separation between *Kochii* and *elongata*, and the latter is regarded by Pilsbry—and not rightly, I think—as a variety of the Mediterranean *P. pulla*. Typical examples of *Kochii* and *elongata* are easily recognizable by their form alone, but the variation in this respect is so gradual that it is easy in a large series of specimens to find the links connecting these extreme forms. They are about the same size, and much larger than the other South African species. *P. Capensis* is only half the size and has a longer spire in proportion to the aperture. *P. bicarinata* is distinguished from the rest of the species by the spiral striation, and *P. neritina* by the characteristic oblique lineation, short spire, and patulate aperture, and on account of these peculiarities it was placed in a new genus, *Chromotis*, by Messrs. H. & A. Adams¹ in 1863. A. Adams described this species in 1850² under the name of *Gena lineata*, and it has been figured under that name in Sowerby's *Thesaurus Conch.*, vol. ii, pl. 173, figs. 26, 27, and by Pilsbry, *Manual of Conchology*, vol. xii, pl. 55, figs. 17, 18, copy of Sowerby. Adams at the time did not know its locality.

The great variation in colour in some species of *Phasianella* is most remarkable, and it occurs notably in *P. Kochii*, *elongata*, and *Capensis*. On the other hand, it is much more regular and characteristic in *bicarinata* and *neritina*; also in the species about to be described there is considerable uniformity.

PHASIANELLA KRAUSSI, n.sp.

Testa parva, ovato-conoidea, imperforata, mediocriter crassa, vix tenuis, nitida, rufo et lacteo variegata; spira brevis, ad apicem obtuse rotundata; anfractus $3\frac{1}{2}$ celeriter accrescentes, convexi, ultimus magnus; sutura simplex, antice valde oblique descendens; apertura magna, ovata, subpatula, longitudinis totius $\frac{1}{2}$ superans; columella arcuata, callo albo induta. Long. 5, diam. maj. 3.5 mm.; apertura 2.75 mm. longa, 2 lata.

Hab.—Kalk Bay, False Bay, Cape of Good Hope.

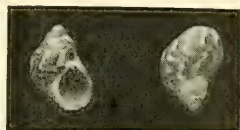
A bottle containing thousands of small *Phasianellas*, mostly *P. Capensis*, was very kindly handed to me by Miss J. M. Reid to make a selection of specimens for the Museum collection. Among them was the species now described, and the very many examples of

¹ Ann. Mag. Nat. Hist., vol. xi, p. 19, 1863.

² Proc. Zool. Soc., 1850, p. 39.

it were separated from the other species without the slightest difficulty.

It is smaller than *P. Capensis*, the only species it can be compared with, is different in form, and the style of coloration is also different. The general outline is more ovate, the spire shorter, the body-whorl larger in proportion to the rest of the shell, and the aperture is also larger and almost patulate. It is difficult to describe the colour. It consists of reddish-brown and creamy or white undulating lines, the reddish-brown colour usually predominating. The white markings



are most conspicuous below the suture on the body-whorl, and they are very frequently bordered on their anterior margin with dark brown, in some specimens in the form of spots. The apex of the spire is pale and pellucid, and sometimes the penultimate whorl is almost without colour-markings, being uniformly corneous. In a few specimens the reddish-brown colour is replaced by a dark purple-brown tint. The dimensions given are those of an average-size example. The largest specimen observed is 6 mm. in length. I have named this species after Dr. Ferdinand Krauss, the well-known author of *Die südafrikanischen Mollusken*.

A LIST OF MARINE SHELLS OCCURRING AT CHRISTMAS ISLAND,
INDIAN OCEAN, WITH DESCRIPTIONS OF NEW SPECIES.

By E. A. SMITH, I.S.O.

Read 7th April, 1911.

IN these Proceedings (Vol. VIII, pp. 369-72) I gave a list of the shells collected at Christmas Island by Dr. C. W. Andrews on his second visit to that island. A few species obtained by him on his first visit are now included in the following catalogue, also those enumerated at the above reference. Mr. R. Kirkpatrick when at the island last autumn collected nineteen species, of which thirteen were not found by Dr. Andrews, four of them being undescribed. These were dredged in 30 to 100 fathoms, and doubtless many other interesting new forms remain to be discovered. Dredging operations around the island, however, are very difficult owing to the rocky nature of the bottom.

1. LIST OF SPECIES.

- | | |
|---|--|
| 1. <i>Glyphis Singaporensis</i> (Reeve). | 32. <i>Engina mendicaria</i> (Lamk.). |
| 2. <i>Haliotis</i> , sp. juv. | 33. <i>Nassa papillosa</i> (Linn.). |
| 3. <i>Trochus Niloticus</i> , Linn. | 34. <i>N. exulata</i> , n.sp. |
| 4. <i>Turbo Lajonkairii</i> , Desh. | 35. <i>Columbella varians</i> , var. |
| 5. <i>Nerita grossa</i> , Linn. | 36. <i>Thais armigera</i> (Lamk.). |
| 6. <i>N. costata</i> , Gmel. | 37. <i>Drupa horrida</i> (Lamk.). |
| 7. <i>N. polita</i> , Linn. | 38. <i>D. clathrata</i> (Lamk.). |
| 8. <i>Plesiotrochus Fischeri</i> , Smith. | 39. <i>D. morus</i> (Lamk.). |
| 9. <i>Truncatella valida</i> , Pfr. | 40. <i>D. Andrewsii</i> (Smith). |
| 10. <i>Amalthea australis</i> (Lamk.). | 41. <i>Coralliophila neritoidea</i> , jun. |
| 11. <i>Mitularia diaphana</i> (Reeve). | 42. <i>Conus hebraeus</i> , Linn., and
var. <i>vermiculatus</i> , Lamk. |
| 12. <i>Cypræa arabica</i> , Linn., and
var. <i>Gillei</i> , Jousseume. | 43. <i>C. minimus</i> , Linn. |
| 13. <i>C. vitellus</i> , Linn. | 44. <i>Terebra undulata</i> , Gray. |
| 14. <i>C. Mauritiana</i> , Linn. | 45. <i>Smaragdinella viridis</i> (Rang.). |
| 15. <i>C. lynx</i> , Linn. | 46. <i>Siphonaria ferruginea</i> , Reeve. |
| 16. <i>C. moneta</i> , Linn. | 47. <i>Arca maculata</i> , Sow. |
| 17. <i>C. annulus</i> , Linn. | 48. <i>A. imbricata</i> , Brug. |
| 18. <i>C. poraria</i> , Linn. | 49. <i>A. decussata</i> , Sow. |
| 19. <i>Cerithium zebra</i> , var. | 50. <i>Brachydontes</i> (<i>Hormomya</i>)
<i>rufolineatus</i> , n.sp. |
| 20. <i>Triphora triticea</i> , Pease. | 51. <i>Septifer bilocularis</i> (Linn.). |
| 21. <i>Planaxis longispira</i> , Smith. | 52. <i>S. excoisus</i> (Wiegman). |
| 22. <i>Latirus nodatus</i> (Martyn). | 53. <i>Melina perna</i> (Linn.). |
| 23. <i>Leucozonias smaragdula</i> (Linn.). | 54. <i>Libitina oblonga</i> (Linn.). |
| 24. <i>Peristernia nassatula</i> (Lamk.). | 55. <i>Tellina scobinata</i> , Linn. |
| 25. <i>P. venusta</i> , n.sp. | 56. <i>Cardium rubescens</i> , n.sp. |
| 26. <i>Mitra fulva</i> , Swainson. | 57. <i>Tridacna gigas</i> , jun. |
| 27. <i>Mitra</i> , sp. juv. | 58. <i>Teredo</i> sp. |
| 28. <i>M. retusa</i> , Lamk. | 59. <i>Xylotrya</i> sp. |
| 29. <i>M. paupercula</i> , Lamk. | 60. <i>Xylotrya</i> sp. |
| 30. <i>M. literata</i> , Lamk. | 61. <i>Polypus granulatus</i> (Lamk.). |
| 31. <i>Tritonidea undosa</i> (Linn.). | |

2. DESCRIPTION OF NEW SPECIES.

PERISTERNIA VENUSTA, n.sp.

Testa minima, breviter fusiformis, albida, ad apicem et antice rosacea, circa medium anfractuum linea fusca cincta, infra suturam inter costas roseo maculata; anfractus 7, duo apicales læves convexi mammillæ-formi, cæteri oblique rotunde costati et spiraliter lirati, lineis incrementi conspicuis sculpti; anfr. ultimus costis septem infra medium evanescentibus instructus, liris spiralibus circiter undecim (quarto, sexto, et octavo fuscis) ornatus, inter liras spiraliter striatus; apertura parva, antice oblique canaliculata; labrum intus tenuiter denticulatum; columella in medio biplicata, rosacea. Long. 7, diam. 3 mm.; apertura cum canali 3 mm. longa, 1.25 lata.



Hab.—Flying Fish Cove, in 45 fathoms. One specimen.

One of the smallest species of the genus and allied to *P. iniuensis*, Melvill, from Savage Island, Oceania. It is, however, a little narrower than that species, has more numerous and finer spiral liræ, and is also distinguished by the brown thread-like line, which, passing round the body-whorl, revolves up the spire. The rosy spots between the upper ends of the costæ also constitute a distinguishing feature.

The lines of growth are well marked and sufficiently strong on crossing the spiral liræ to give them a crenulated appearance. The two plicæ on the columella are, in fact, the continuation of two liræ upon the end of the whorl.

NASSA EXULATA, n.sp.

Testa elongata, angusta, acuminata, alba, dilute fusco interrupte balteata; spira elongata, acuminata; anfractus 9, tres apicales læves, convexi, cæteri minus convexi, sutura profunda sejuncti; anfr. superiores costis obliquis 16–18 instructi, liris tenuibus spiralibus circiter 6 cincti, liris in anfr. anterioribus 2–3 sensim evanescentibus; anfractus ultimus lævis, circa basim striis paucis sculptus, zonis tribus interruptis pallide fuscis ornatus, infra suturam spiraliter striatus, lineis incrementi tenuibus sculptus; apertura parva, ovalis, albida; labrum extra incrassatum, album, intus denticulis 9–10 vix conspicuis instructum; columella arcuata, callo albo, superne tenui unidenticulato, antice incrassato, induta. Long. 13, diam. 5.5 mm.; apertura cum labro 5 mm. longa, intus 2.5 lata.

Hab.—Off Margaret Beaches, in 100 fathoms. One specimen.

A slender form of *Nassa* with a small aperture and long spire. About three and a half of the upper whorls are prettily sculptured,

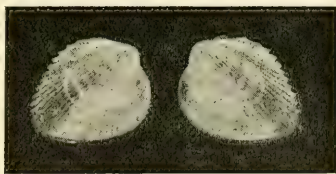
and then the ornamentation begins to die away, so that the last and penultimate whorls appear almost smooth to the naked eye, except a few striæ round the lower part of the former. The colour-markings are pale brown, and consist on the penultimate whorl of two indistinct,



rather interrupted zones, one below the upper suture and the other above the lower suture. These two bands are continued on the body-whorl, and there is a third around the base. As in many species, the upper margin of the whorls is somewhat distinctly marked off.

CARDIUM (FRAGUM) RUBESCENS, n.sp.

Testa parva, tenuis, valde inæquilateralis, trigono-cordata, antice brevissima, alba, postice producta, leviter acuminata, rubescens, interdum omnino rubescens, costis radiantibus circiter 38 instructi; costæ supra medium valvarum fere planæ, delicate squamulatæ, longe latiores quam sulcis separantibus; costæ anteriores et posteriores angustiores, fortius squamosæ, magis prominentes, sulcis latoribus profundioribus transversim sculptis separatæ; valvæ tenues, ad marginem ventralem leviter denticulatæ, postice fortiter dentatæ; pagina interna antice alba, postice rubescens vel undique rubescens, radiatim sulcata. Long. 8, alt. 6.5, diam. 5.5 mm.



Hab.—Flying Fish Cove, in 30 fathoms.

Allied to *C. crenelloides*, Melvill, and *carditæformis*, Reeve, both Indian Ocean species; there are differences, however, of form, colour, and sculpture, which distinguish these three one from the other. *C. carditæformis* is longer, the ribs are finer and more numerous, and the colour different. *C. crenelloides* is narrower in front, and less acuminate behind, has more ribs, and is devoid of colour.

Two specimens were obtained by Mr. Kirkpatrick, one entirely rosy-red, the other with the front half of the valves almost white, and the

hinder portion stained with rosaceous, the colour in two more or less suffused rays. The radiating riblets upon the middle of the valves are very faintly convex, and separated by mere impressed lines. These become more distinct grooves both anteriorly and behind. The lines of growth are distinct in the grooves, and in the impressed striæ produce an almost punctate appearance.

BRACHYDONTES (HORMOMYA) RUFOLINEATUS, n.sp.

Testa elongata, radiatim et concentrice lirata, undique granulata, periostraco hirsuto induta, sordide albida, postice rufo maculata et lineata; margo cardinalis supra ligamentum brevis, rectus, postice vix angulatus; margo ventralis leviter incurvatus; valvæ tenues, ad marginem intus denticulatæ, iridescentes, rufo lineatæ et variegatæ; margo cardinis ante ligamentum dentibus tribus validis, quatuor minoribus posticis instructus; umbones pallidi, nitentes, concentrice striati, haud radiatim sculpti. Long. 10·5, alt. 5·5, diam. 5·3 mm.



Hab.—Flying Fish Cove, in 30 fathoms.

Allied to *Brachydontes (Hormomya) Karachiensis*, Melvill & Standen, but different in form, owing to the shorter hinge-line and the less marked dorsal angle. The concentric sculpture in the present species is also stronger, causing the radiating liræ to be more granulous. The colour-markings constitute another distinguishing feature, and the periostracum in *Karachiensis* appears to be of a less hairy nature.

The margin of the valves is most strongly denticulate along the dorsal and hinder edges, and somewhat more finely on the ventral side, excepting at the byssal opening, which is smooth.

ON THE VALUE OF THE GASTROPOD APEX IN CLASSIFICATION.

By TOM IREDALE.

Read 10th March, 1911.

IN the Proc. Malac. Soc., vol. ix, p. 74, 1910, I recorded the occurrence of the *Sinusigera* apex in species of *Alectrion*, and suggested it would prove a valuable aid to the future monographer of that difficult group. Since then I have carefully searched through all my Kermadec material (unfortunately very scant), simply examining every juvenile specimen, with quite surprising results. I will here detail the facts before touching upon the lessons which seem to be pointed out.

My first find was a juvenile *Mitra*, of which I had obtained no adults, which clearly showed the apex to be *Sinusigera*. A much more elongate *Sinusigera* was found attached to a couple of post-embryonic whorls, which led to its identification as the young of *Turris cingulifera*, Lamk. Some of my smaller Turrids had been noted as possessing many-whorled protoconchs, and examination elicited their *Sinusigera* character. These were specimens of the *unizonalis*, Lamk., group, and this group has been usually referred to *Drillia*. Figures of *Glyphostoma* and *Clathurella* insinuate the occurrence of *Sinusigera* apices in these genera. Dall has recently written (Bull. Mus. Comp. Zool. Harvard, vol. xliii, p. 260, 1908), "The nucleus of *Daphnella*, on the other hand, is a typical '*Sinusigera*,'" and of *Eubela* (same page), "nucleus of the *Sinusigera* type." Throughout that paper Dall appears to attach importance to the features of the apex in the Turritidæ, though twenty years previously he had concluded (same journal, vol. xviii, p. 75), "as far as our knowledge goes, nuclear characters have little absolute systematic value in this group, and their relative value remains to be determined." I anticipate that study of the apices will provide the solution of the intricate problem presented by this group of molluscs.

Inasmuch as the majority of the larger molluscs met with at the Kermadecs clearly indicated their arrival as juveniles by means of free-swimming larvæ, the only large *Columbella* found was examined, and at once a *Sinusigera* was observed. The apex of *Terebra* has been constantly noted, but its *Sinusigera* character appears to have escaped attention. Thus, as regards the *Sinusigera*, at Sunday Island I have traced it in the families Mitridæ, Buccinidæ, Alectrionidæ, Thaitidæ, Columbelloidæ, Coralliophilidæ, Turritidæ, and Terebridæ.

Craven, in his *Monographie du genre Sinusigera*, D'Orb. (Ann. Soc. Roy. Malac. Belg., vol. xii, pp. 105 et seq., 1877), describes and figures many diverse forms of *Sinusigera*. I cannot yet definitely locate some of his figures, but one is undoubtedly the apex of a species of *Triphora*, as was afterwards admitted by Craven himself. This led Fischer to write (Manuel Conch., p. 651, 1884): "On a compris dans ce genre des embryons de *Cerithium*, de *Triforis*, de divers genres de Tænioglosses, et peut-être aussi de Rhachiglosses (*Purpura*). La

lobation du labre est très remarquable." That *Triphora* owes its wide distribution to this factor is apparent, but it seems that the animal still swims after the adult whorls are forming, as witness Fischer (loc. cit., p. 679): "Nous avons pêché en pleine mer, entre la Provence et la Corse, un *Triforis perversa*, dont la coquille comptait 8 à 9 tours, et dont l'animal avait les caractères larvaires." From my own observations I should doubt the possibility of such an occurrence in connexion with the 'Thaitid' *Sinusigera*.

These 'Triforid' *Sinusigeras* are much different in shape and form from the 'Thaitid' *Sinusigera*. They are much more minute and elongate, and the claw is in reality the only resemblance.

Hitherto recorded in the genera *Triphora* and *Bittium* they would appear to exist in many other genera also. *Planaxis Brasilianus*, Lamk., was common at Sunday Island, but no adult specimen ever showed a perfect apex; minute dead specimens from shallow water dredgings, however, proved it to possess a very minute dark-coloured *Sinusigera* apex. Dall has recently recorded this species from that outpost of Pacifica, Easter Island (Bull. Mus. Comp. Zool. Harv., vol. xliii, p. 437, 1908). I have since noted similar apices attached to other species of *Planaxis*.

A shell, once dredged alive at Sunday Island, has been identified as *Cerithium sinon*, Bayle (Journ. de Conch., vol. xxviii, p. 243, 1880). It was described as *Cerithium clathratum* by Sowerby (Thes. Conch., vol. ii, p. 883, 1855) from the Island of Bohol; it has been recorded by Melvill & Standen (Journ. Conch., vol. viii, p. 116, 1895) from Lifu as *Cerithiopsis sinon*, and there are specimens in the British Museum from Mauritius. I have seen no adult with a perfect apex, but juveniles from dredgings revealed the existence of a minute *Sinusigera*. I don't know where to generically locate this shell, but it is certainly neither a *Cerithium* nor a *Cerithiopsis*. Other juvenile Cerithioids from the dredgings also showed minute *Sinusigera* apices, but here again no adults were obtained. The suggestion that *Cerithium* also travels by means of a *Sinusigera* I have not yet been able to confirm, but I feel certain that such will prove to be the case.

A shell I did not collect at Sunday Island, but which has since come to my notice, is a species of *Fenella*. I suggest that the minute many-whorled apex of *Obtortio* is of a *Sinusigera* character.

In recent years scarcely any scientific worker has described a new minute shell without carefully detailing the apical characters and using them for classificatory purposes. Yet these same workers have been content to class larger well-known shells in an almost Linnean fashion. To specify a glaring instance, the northern *lapillus*, Linné, is classed with the southern *succincta*, Lamarck, in *Thais*. But the apices of both these species are well known and are quite dissimilar. In the paper quoted I wrote: "I should therefore state that no species should be allotted to a group of which the type has been shown to possess a *Sinusigera* apex, unless it also possess such an apex. And I would anticipate that all such groups will later be raised to the rank of genera."

Since this was written I have noted that I had been anticipated by

Grabau (Amer. Nat., vol. xxxvi, p. 922, 1902), who concluded from the study of dissimilar molluscs, "I believe it is not too much to say that the protoconchs of all the species within a given genus should agree as to their essential characteristics, and that no species can be considered congeneric in which the protoconch shows a radical difference," and added, "The smaller the taxonomic group the more nearly identical must be the earlier stages, since in a small group the members have not become widely separated from their common ancestor."

My researches lead me to endorse these statements, though a recent writer (Burnett Smith, Proc. Acad. Nat. Sci. Philad., vol. lix, p. 242, 1907) has arrived at an opposite view from a study of molluscs similar to Grabau's specimens.

A splendid instance that would confirm Grabau's second item is that of the *Thais succincta*, Lamk., group. Thus, the allotment of juveniles of a mixed lot of *T. succincta*, Lamk., *T. striata*, Mart., *T. tritoniformis*, Blainv., and *T. Smithi*, Brazier, to each species is almost an impossibility, though the adults are easily separable. I only cite this case, but various others could be quickly produced, e.g. the *Trophon Geversianus* group, the New Zealand '*Siphonalia*', or the New Zealand '*Euthria*'.

It should be carefully noted that the material point in Grabau's dictum is the presence in the protoconchs of "a radical difference". This is most important, as size generally does not constitute a "radical" difference. Moreover, it is rarely possible to absolutely indicate the nature of an apex from a casual examination of an adult shell, and very often also from quite juvenile shells.

That many species owe their distribution to their free-swimming *Sinusigera* larvæ appears to be completely proved from the examination of almost any Pacific island marine molluscan fauna, when the majority of the species are at once recognizable as possessing free-swimming larvæ of varied kinds, as *Tonna*, *Septa*, *Cassidea*; others, as *Thais*, *Alectrion*, *Columbella*, Cerithioids, *Triphora*, *Mitra*, have just been shown to be *Sinusigera* as juveniles; next would come *Strombus*, *Cypræa*, *Conus*, of which we do not know yet the absolute character of the larva; then we have the Solarioids, which we know to travel by means of free-swimming larvæ of a kind totally at variance with the preceding, namely, that peculiar pseudo-sinistral mollusc described as '*Agadina*'; lastly, shells which though having a wide range apparently give no clue to their means of distribution.

The '*Agadina*' stands clearly revealed when such a widely umbilicated shell as *Helicacis crenellus*, L., is observed: it is not so easily seen in a species like *Architectonica cingulum*, Kiener. It occurred to me that it would scarcely be noticeable in an imperforate shell, the sinistral apex being then the only clue. Whilst considering that this might be the solution of some of my puzzles I stumbled upon an '*Agadina*' commencing a post-embryonic whorl. It was obvious the shell was not a Solarioid, and, moreover, that it was going to be imperforate of a peculiar kind. I could not place it anywhere near the Solarioids, the only group to which '*Agadina*' had hitherto been traced. The

wide range of the Tectibranchs suggested inquiry, and almost the first one I examined revealed the adult of my imperforate '*Agadina*', namely *Bullina scabra*, Gmelin. I then carefully examined the whole of my Kermadec Tectibranchs, with the results that I believe the majority owed their distribution to '*Agadina*' larva. In some cases it was apparent, in others only suggested. Thus *Bullaria* gave it, *Pleurobranchus* showed it, *Dolabrifer* and *Umbraculum* apparently possess it, whilst I could not get juveniles of others of which the adults gave indeterminate results. I have said we do not yet know the absolute character of the juveniles of *Strombus*, but the apices of some species are clearly swimmers, though of quite a peculiar nature. *Cypræa*, I believe, has a *Sinusigera* juvenile: I have examined young specimens showing apices clearly comparable with a Thaitid apex, but the post-embryonic whorls clasp the embryo so high up that the absence or presence of a claw cannot be even guessed at. A similar apex and similar remarks apply to *Harpa*, whilst I have been unable to get any clue whatever as to the nature of the apex of *Conus*. The apex of *Ianthina* has been often described, but here again I cannot decide whether it is a *Sinusigera* or not, though my best specimens certainly point to the affirmative.

Now the mass of work to be done on the apices of described shells is surely apparent, and I believe our present classifications will be considerably improved when we know the nature of the juveniles of our molluscs. I consider that basing our systems even upon the nature of the animals, without taking into consideration the character of the juveniles, is a mistake. In every other branch of science the study of juvenile forms has led to results of the greatest importance, and I think that will be found to apply to the Marine Mollusca. At present the majority of the genera commonly in use are heterogeneous, obviously so, yet when a writer splits them up instead of an attempt being made to confirm or reject his conclusions, they are ignored. I have instanced the case of '*Thais*' *lapillus*, L., and *succincta*, Lamarck: it might be thought that this lumping was due to the fact that no one had pointed out the error. But it has been often indicated, and Troschel, working upon the radular characters, split up the genus *Thais* (*Purpura* as it was at that time called) into several genera. Though it is acknowledged by every careful worker that *Thais* is a mixture of incongruous elements, no one has definitely criticized Troschel's action, but as far as I can see simply overlooked it and continued the perpetuation of obvious errors. I believe that a study of the apices of this group would lead to a reorganization of our ideas, and confirmation or rejection of the divisions proposed by Troschel. My own incomplete studies suggest that Troschel's genera are, to a great extent, natural.

Another instance is the genus *Triphora*. Here again the work of subdivision has been done so that the apical features can be used for confirmatory purposes. As a matter of fact, every one who has handled many specimens of *Triphora* knows the beautiful and diverse styles of apex that occur in that genus. It is an impossibility for one individual to work out the many complex problems that are presented

by a study of the apices of the Marine Gastropods, and it is to draw attention to the importance of this study that this note is written. There seems to be no doubt whatever that in addition to the genera I have named, *Cantharus*, *Peristernia*, *Euthria*, *Drupa*, *Siphonalia*, to quote only the first that come to mind, are, as at present constituted, polyphyletic, and until the work of dismemberment suggested by the apical features is carried out, all attempts at higher groupings must prove futile.

ON *VALVATA WOODWARDI*, N.SP., AND *SPHÆRIUM BULLENI*, N.SP., FROM THE CROMERIAN (FOREST BED) OF WEST RUNTON, NORFOLK.

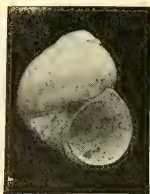
By A. S. KENNARD, F.G.S.

Read 10th March, 1911.

DURING the past few years a large quantity of material from the Cromerian (Forest Bed) of West Runton, Norfolk, has been placed at my disposal by M. A. C. Hinton, and I myself have also collected from the same deposit. A close study of this has revealed the necessity for a revision of the published lists of species, and considerable progress has been made. Since, however, it is unlikely that this will be finished for some little time I have considered it advisable to publish descriptions of these two new species, since it is necessary to quote them. The molluscan remains have been obtained from two distinct layers just east of West Runton Gap. The uppermost bed is a sandy gravel full of shells. It is about 8 inches thick and about 5 feet above the level of the beach. There can be no doubt that this is the bed described by Mr. Clement Reid¹ as—"Near West Runton Gap the bed is a loamy sand full of *Corbicula fluminalis* and *Paludina gibba*." As a matter of fact *Corbicula fluminalis* does not occur, the shell which has been mistaken for it being *Sphærium rivicola*, Leach. The other bed is one apparently older, and is a silty peat occurring on the foreshore, more to the eastward. Mr. Hinton informs me that, judging from the fossil Rodentia, there is considerable difference in age between the two, the palæontological evidence supporting the stratigraphical. Both the new species were very common in the upper bed, though not so abundant in the lower.

VALVATA WOODWARDI, n.sp.

Shell conical, solid, rather glossy, closely and finely striate in the lines of growth; whorls $4\frac{1}{2}$ –5, convex; body-whorl very large; apex somewhat sharply pointed; suture oblique, shallow; mouth oval,



angulated above; umbilical chink narrow; operculum unknown. Height 9, breadth 7 mm.

Locality and Formation.—West Runton, Norfolk: Cromerian (Forest Bed).

¹ *Pliocene Deposits of Britain* (Mem. Geol. Survey), 1890, p. 156.

Examples of this species were submitted to the late Dr. O. Boettger (whose death we so greatly deplore) and were pronounced by him to be new to science. There can be but little doubt that this is the *Valvata fluviatilis*, Colbeau, of F. Sandberger ("Ein Beitrag zur Kenntniss der unterpleistocänen Schichten Englands": Palæontographica, 1880, p. 100, Taf. xii, figs. 4-4b), and of Clement Reid (op. cit., pl. v, figs. 7a-b). *V. fluviatilis* is, however, only a form of *piscinalis*, and is much smaller than *Woodwardi*, besides differing in the suture, apex, and body-whorl. The nearest living ally of *Woodwardi* is *V. naticina*, Menke, a Central European species.

I have great pleasure in associating the name of our former President with this species as a slight recognition of his valuable services to Malacology.

SPHERIUM BULLENI, n.sp.

Shell ovate, nearly equilateral, very swollen, with front margin very curved, very slightly curved ventrally, anterior and posterior margins being almost equally semicircular. Exterior showing lines of increment at irregular intervals. Umbones nearly central, very prominent, tipped with the embryonic shell. Length 9, breadth 8, thickness 7 mm. The embryonic shell measures 2×1.5 mm.



Teeth: Right valve. Hinge-plate slightly curved either side of cardinal area. This curvature is greatly accentuated in old and thickened specimens by the great development of inner lateral teeth. Cardinal 3 almost semicircular, 3 b. bifid, and about twice the width of a.; lateral teeth very strong, especially inner ones, a.l. 1 stout and curved towards interior of shell, apex nearly median, the cardinal side being more steeply incurved; a.l. 3 short and stout, its apex the same distance from cardinal as a.l. 1; p.l. 1 straighter and narrower than a.l. 1, apical point less pronounced, and vertical ridge curves on either side nearly equal; p.l. 3 nearly as long as p.l. 1, its apex slightly nearer the cardinal than that of p.l. 1, the cardinal end of p.l. 3 considerably swollen and thickened as it approaches the ligament pit, which is long, narrow, and moderately deep.

Left valve. Cardinal teeth (c. 2) set obliquely across hinge-plate, forming angle of about 45° with lower margin, short, and moderately pointed; c. 4 longer, straighter, almost parallel with hinge-line, and stretching towards ligament pit, is almost twice the length of c. 2; lateral teeth projecting more beyond margin than those of right valve; apices towards the distal ends of ridges, which are boldly curved on cardinal and steeply curved on distal. The outline of apex curved away from cardinal region.

Examples of this *Sphærium* were also submitted to the late Dr. O. Boettger, who pronounced them to belong to a new species. He stated that its nearest ally was *Sphærium mamillanum*, West., but that it differed from that species in being larger (Westerlund's dimensions for his species being $8 \times 5\frac{1}{2} \times 4\frac{1}{2}$ mm.), in the umbo being far more prominent, and in being a far thicker shell. This species is the *S. ovale*, Fér., of Clement Reid (op. cit., p. 230).

Locality and Formation.—Cromerian (Forest Bed) of West Runton, Norfolk.

It affords me great pleasure to associate with this species the name of the Rev. R. Ashington Bullen, B.A., whose enthusiasm in the interests of science is well known to all members of this Society.

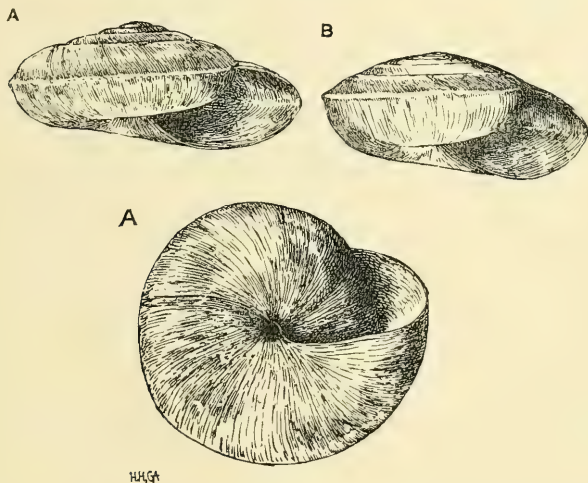
DESCRIPTION OF *OXYTES BEDDOMEI*, N.SP., FROM
UPPER BURMA.

By Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S.

Read 7th April, 1911.

OXYTES BEDDOMEI, n.sp. Figs. A, B.

Shell narrowly umbilicated, depressed, lenticular, well keeled, somewhat flattened below, with oblique, regular transverse striæ, on the second whorl under high power; three to four fine longitudinal impressed lines render the striæ discontinuous; this disappears on the last three whorls. Colour pale ochraceous, with a violet tinge at the apex in one specimen, and paler below; spire low, apex rounded, sides flatly convex; suture shallow; whorls 6, regularly increasing, flatly convex; aperture semi-lunate, oblique; peristome thin, somewhat sinuate on the lower margin, thicker near the upper angle of the aperture; columellar margin scarcely reflected, sharp, obliquely descending. Maj. diam. 38·5, min. 34·3 mm.; alt. axis, 11·5 mm.

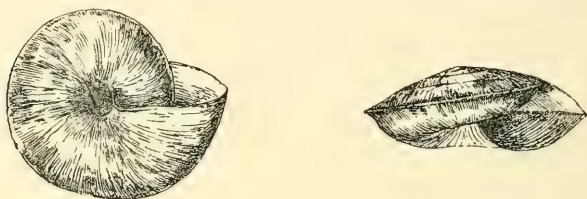


Hab.—Ruby Mines, Upper Burma. (Mr. Lace, Forest Department.)

Two specimens were sent me by Colonel Beddome last autumn for examination and comparison with species in my collection. I considered them new, and Colonel Beddome, writing to me on 16th January, said: “You had better describe the new *Oxytes*; it was taken by Mr. Lace (Forest Officer) at the foot of the hills at the Ruby Mines . . . You can give my new *Oxytes* to the Museum.”

Having other work to do, the description was deferred, and now,

while writing, there is the shadow of much sadness over this communication. For the letter quoted above was the last he wrote to me, and although I saw him at the Museum in January, and apparently well, we heard of his sudden death on the 23rd February. He was a conchological friend for many years, among the first I made in India, associated with many others who have gone. This is not the place for an obituary notice, which I hope soon to give to the Malacological Society.



C.

There is very little doubt as to the generic position of this species, yet it will be of interest to see the animal and ascertain whether so far to the eastward the generative organs follow those of *O. orobia* from Sikhim (vide *Fauna British India*, p. 170, fig. 60), which, with those of *O. cycloplax*, are on the same plan as is seen in *Macrochlamys*.

This species in general form and narrow umbilicus is near *O. castor*, Theob., of the Khasi Hills, but it may be distinguished at once by its lower, flatter apex. *O. Shanensis*,¹ G.-A., is a somewhat similar shell, but far more widely and openly umbilicated. As this shell was not figured at the time it was described I now take the opportunity of giving drawings of it. Figs. C.

¹ *Moll. Ind.*, vol. i, p. 128, 1883, and *Fauna British India*, 1908, p. 168.

ORDINARY MEETING.

FRIDAY, 12TH MAY, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Mr. Harold Hannibal was elected a member of the Society.

The President moved the following resolution:—

“That the Malacological Society of London views with great anxiety the proposal to provide for the extension of the Science Museum by assigning for that purpose a part of the site which has hitherto been regarded as belonging to the British Museum (Natural History).

“Its members desire to express their opinion that the growth of the British Museum (Natural History), which must inevitably take place as time goes on, will require the whole of the site which is bounded to the north by the line fixed by the Treasury and the Office of Works in 1899. They consider that it would be a grave misfortune if the development of the Museum were to be cramped in the future by a reversal of the policy which allocated a substantial margin of ground for that purpose. They venture to express the hope that it will be possible to provide for the extension of the Science Museum without encroaching on the site of the British Museum (Natural History).

“That copies of this resolution be forwarded to the Prime Minister, the Trustees of the British Museum, and the Press.”

The Rev. R. Ashington Bullen, B.A., F.L.S., seconded the resolution, which was carried *nem. con.*

The following communications were read:—

1. “Some remarks on the nomenclature of the Veneridæ.” By Dr. W. H. Dall.

2. “Description of a new species of the genus *Conus* from South Africa.” By G. B. Sowerby, F.L.S.

3. “A Modification in the Form of Shell (*Siphonaria Algesiræ*, Quoy) apparently due to Locality.” By the Rev. A. H. Cooke, M.A., F.Z.S.

Mr. E. A. Smith exhibited an abnormal specimen of *Cypræa lynx* with expanded lip; an immature shell of *Cypræa caput-serpentis*, which was devoid of the usual spots and markings; and a remarkable colour variety of *Strombus quadratus*, being of a beautiful salmon pink.

The Rev. R. Ashington Bullen exhibited a series of living Mollusca collected on or about March 14th in the Bermudas, including: *Pæcilozonites Bermudensis*, *Helicina convexa*, *Eulota similis*, *Vitrea lucida*, *Polygyra microdonta*, *Helicella ventricosa*, *Rumina decollata*, and an unidentified species of *Helicella*. Of these *Vitrea lucida* deposited some eggs in the tube while on the voyage.

Mr. G. B. Sowerby exhibited a small specimen of *Cypræa tessellata*, which was beautifully spotted.

ORDINARY MEETING.

FRIDAY, 9TH JUNE, 1911.

R. BULLEN NEWTON, F.G.S., President, in the Chair.

Mr. W. J. Farrer was elected a member of the Society.

The following communications were read:—

1. "Description of a new species of *Aemæa* from Bombay, and notes on other forms from that locality." By E. A. Smith, I.S.O.
2. "Diagnoses of three new Operculate Land Shells from Grand Cayman Island." By H. B. Preston, F.Z.S.
3. "Further note on preoccupied Molluscan Generic Names, and a proposed new genus of the family Helicidæ." By G. K. Gude, F.Z.S.
4. "On the modifications in form of the Upper Tertiary lacustrine shells of the Island of Cos, as first observed by Edward Forbes and T. A. B. Spratt." By R. B. Newton, F.G.S.

Mr. H. B. Preston exhibited a living example of an undetermined species of *Ampullaria* from Entebbe, Uganda, which upon being placed in a bowl of water began to devour some lettuce leaves which had been put within its reach.

ON THE MOLLUSCA PROCURED DURING THE "PORCUPINE"
EXPEDITIONS, 1869-70. SUPPLEMENTAL NOTES, PART IV.¹

By E. R. SYKES, B.A.

Read 13th May, 1910.

THE following pages complete the account of the Gastropods which were not described by Jeffreys, and in the next part I hope to take up the work of supplementing the portion already published by him, and to deal with a number of minute forms which had not been fully investigated ere his death. The figured specimens are in the British Museum.

DONOVANIA LINEOLATA (Tiberi).

Nesæa lineolata, Tiberi, Journ. Conchyl., 1868, p. 76, pl. v, fig. 5.

"Porcupine" Expedition, 1870, Adventure Bank, 92 fathoms; Station 30.

Two specimens, from Station 30, were separated by Mr. Marshall with a note that they appeared possibly distinct from *D. lineolata*, and that the Marquis de Monterosato was unable to identify them. I am inclined to consider them as only a variety of this form. One box of similar specimens in the Museum bears the Station numbers 26, 27, 28, 28a; their accuracy is doubtful.

DONOVANIA MINIMA (Montagu).

Buccinum minimum, Montagu, Test. Brit., i, p. 247.

"Porcupine" Expedition, 1870, Tangier Bay, 35 fathoms; Station 50.

Distribution.—British Isles to Madeira and Mediterranean. Fossil in Pliocene.

The specimens from the first locality belong to the variety *pallescens*, Jeff.

DONOVANIA VULPECULA (Monterosato).

Lachesis vulpecula, Monterosato, Not. Conch. Med., 1872, p. 49.

"Porcupine" Expedition, Station 50; Adventure Bank, 92 fathoms.

Distribution.—Mediterranean.

CONUS MEDITERRANEUS (Hwass.), Bruguière.

Conus Mediterraneus, Bruguière, Ency. Méth., iv, pl. cccxxx, fig. 5.

"Porcupine" Expedition, 1870, Benzert Road, 40-65 fathoms; Adventure Bank, 92 fathoms.

Distribution.—Generally throughout the Mediterranean. A Tertiary fossil.

The stations are taken from the boxes in the British Museum; the locality of "Cadiz" also appears.

¹ For Parts I, II, and III, see Vol. VI, pp. 23, 322; Vol. VII, p. 173.

CANCELLARIA CANCELLATA (Linné).

Cancellaria cancellata, L.: Jeffreys, Proc. Zool. Soc., 1885, p. 49.

Distribution.—See Kobelt, Icon. Europ. Meeresconch., iii, p. 210; and Locard, Expéd. Trav. Talisman, i, p. 302.

CANCELLARIA CORONATA, Scacchi.

Cancellaria coronata, Scacchi, Notizie, p. 34; Philippi, Moll. Sicil., ii, p. 177, pl. xxv, fig. 27.

“Porcupine” Expedition, 1870, Adventure Bank, 92 fathoms.

Distribution.—Several deep-water localities in the Mediterranean. A fossil in Sicilian, etc., Tertiary.

CANCELLARIA MINIMA, Reeve.

Cancellaria minima, Reeve: Jeffreys, Proc. Zool. Soc., 1885, p. 49.

Add to localities of the cruise of 1870, Stations 26, 27.

CANCELLARIA PUSILLA, H. Adams.

Cancellaria mitraformis, Brocchi: Jeffreys, Proc. Zool. Soc., 1885, p. 49.

I think the recent shell is distinct from the fossil; there is already a *C. pusilla*, Sby.,¹ but I do not add to the nomenclature as there is some doubt. Add Stations 26 and 27 (J. T. Marshall).

ADMETE VIRIDULA (Fabr.).

Cancellaria viridula, Fabr.: Jeffreys, Proc. Zool. Soc., 1885, p. 48.

Add to cruise of 1870, Stations 3 and 17 (J. T. Marshall).

MARGINELLA CLANDESTINA, Brocchi.

Marginella clandestina, Brocchi, Conch. Foss. Subapp., ii, p. 642.

“Porcupine” Expedition, 1870, Stations 3, 30, 50, 56; Adventure Bank, 92 fathoms.

Distribution.—Throughout the Mediterranean. A Tertiary fossil.

Several other station numbers appear on the Museum boxes, but I am doubtful as to them.

MARGINELLA HESPERIA, SYKES.

Marginella hesperia, Sykes, Proc. Malac. Soc., vi, p. 316, pl. xvii, fig. 7, 1905.

“Porcupine” Expedition, 1870, Station 24.

Two specimens of what probably is a dwarf form of this species are in the Museum, but as the box containing the two shells bears three station numbers I forbear to quote them.

MARGINELLA MILIARIA (Linné).

Voluta miliaria, Linné, Syst. Nat., 10th ed., p. 730.

“Porcupine” Expedition, 1870, Station 50; Gibraltar Bay, 3 fathoms (Brit. Mus.); Algeiras Bay, 1–15 fathoms (Brit. Mus.).

¹ Conch. Illustr., *Cancellaria*, p. 6, 1833.

Distribution.—Mediterranean, also Canaries. A Tertiary fossil in S. Europe.

MARGINELLA MINUTA, Pfeiffer.

Marginella minuta, Pfeiffer, Wiegmann's Archiv, i, p. 259, 1840.

"Porcupine" Expedition, 1870, Stations 17, 30, 50, 56; Adventure Bank, 92 fathoms.

Distribution.—According to Tryon the species is also found in the West Indies, Florida, and the Red Sea. A Pliocene fossil.

MARGINELLA OCCULTA, Monterosato.

Marginella occulta, Monterosato, Test. Nov. Siciliæ, p. 17, 1869.

Gibberula occulta, Monterosato, Locard, Expéd. Trav. Talisman, i, p. 133.

"Porcupine" Expedition, 1870, Adventure Bank, 92 fathoms.

Distribution.—Several deep-sea localities in the Mediterranean. A Pliocene and post-Pliocene fossil.

ERATO LÆVIS (Donovan).

Voluta lævis, Donovan, Brit. Shells, v, pl. clxv.

"Porcupine" Expedition, 1869, Little Minch, 60–80 fathoms; Stations 2, 23a; 1870, Adventure Bank, 92 fathoms; Cape Sagres, 45–58 fathoms; Station 50.

Distribution.—North Atlantic and Mediterranean.

CYMBIUM PAPILLATUM, Schumacher.

Cymbium papillatum, Schumacher, Nouv. Syst., 1817, p. 237; Kobelt, Icon. Europ. Meeresconch., ii, p. 1.

"Porcupine" Expedition, 1870, off Cape Sagres, 45–58 fathoms.

Distribution.—Mediterranean and Atlantic.

One very dead shell.

HALIA PRIAMUS (Meuschen).

Helix Priamus, Meuschen, Cat. Mus. Gron., No. 1353.

Halia Priamus, Meuschen: Kobelt, Icon. Europ. Meeresconch., ii, p. 6.

"Porcupine" Expedition, 1870, Stations 26 (fragments), 30 (fragments); off Cape Sagres, 45–58 fathoms.

Distribution.—From Spain to Senegal. Fossil in the Italian Pliocene (Jeffreys).

"In the Porcupine Expedition of 1870, I dredged, off Cape Sagres, together with a perfect specimen of *Halia*, a rather large valve of *Avicula hirundo*, on which were affixed three ovi-capsules of the present species. One of the capsules or cases enclosed two young specimens of *Halia*; each of the other two containing only a single specimen. The young were marked with a row of the usual interrupted spots above the rim of the outer lip. These capsules were solitary and closely resembled those of *Buccinopsis* [*Liomesus*]. The apex of the shell and the canal are alike in both genera. Judging from the

highly polished surface of the shell in *Halia* I should conclude that its voluminous foot could enclose and cover the shell, as in *Ancilla*, *Eburna*, or *Cypræa*, and, to a certain extent, as in *Natica* (Jeffreys)."

VOLUTOMITRA GRÆNLANDICA (Beck), Möller.

Mitra Grænlantica (Beck). Möller, Index Moll. Grænlantiæ, p. 15;
Kobelt, Icon. Europ. Meeresconch., ii, p. 4.

"Porcupine" Expedition, 1869, Stations 23a (J. T. Marshall), 65 (Brit. Mus.), 74 (J. T. Marshall and Brit. Mus.).

Distribution.—Northern and Arctic seas.

MITRA BICONICA, n.sp.

Shell elongate, pale yellow (dead), rather solid; whorls 6-7, rather flattened, with a well-marked suture; protoconch smooth; the residue of the shell is marked by numerous, densely set spiral striæ, crossed by a few obsolete longitudinal ribs; mouth elongate, narrow; columella with two folds; outer margin sulcate within. Alt. 9, lat. 3 mm.



"Porcupine" Expedition, 1870, Station 24.

Somewhat resembling an elongate form of the well-known Pleurotomoid, *Mangilia septangularis*.

MITRA COLUMBELLARIA, Scacchi.

Mitra columbellaria, Scacchi, Cat., p. 10, figs. 12, 13; Kobelt, Icon. Europ. Meeresconch., ii, p. 56.

"Porcupine" Expedition, 1870, Adventure Bank, 92 fathoms; Benzert Road, 40-65 fathoms; Stations 50, 56.

MITRA CORNICULA (Linné).

Voluta cornicula, Linné, Syst. Nat., 12th ed., p. 1191.

Mitra cornicula, Linné: Kobelt, Icon. Europ. Meeresconch., ii, p. 50.

"Porcupine" Expedition, 1870, Station 50 (one immature shell).

Distribution.—Mediterranean Sea, and also in the Atlantic.

MITRA EBENUS, Lamarek.

Mitra ebenus, Lamarek, Ann. du Mus., xvii, No. 58; Kobelt, Icon. Europ. Meeresconch., ii, p. 47.

"Porcupine" Expedition, 1870, Station 58 (Brit. Mus.).

Distribution.—Various Mediterranean localities.

MITRA TRICOLOR (Gmelin).

Voluta tricolor, Gmelin, Syst. Nat., 13th ed., p. 3476.

Mitra tricolor, Gmelin: Kobelt, Icon. Europ. Meeresconch., ii, p. 54.

"Porcupine" Expedition, 1870, Adventure Bank, 92 fathoms (J. T. Marshall).

Distribution.—Mediterranean.

MITRA ZONATA, Marryat.

Mitra zonata, Marryat, Trans. Linn. Soc., xiii, p. 338; Kobelt, Icon. Europ. Meeresconch., ii, p. 45.

"Porcupine" Expedition, 1870, Station 50 (J. T. Marshall).

Distribution.—Several localities in the Mediterranean. Pliocene and (?) Miocene.

FUSUS BROCCII (Monterosato).

Murex Broccii, Monterosato, Nuova Rivista, p. 39.

Fusus Broccii, Monterosato: Kobelt, loc. cit., i, p. 54.

Murex craticulatus, Brocchi, non Linné.

Non *Tritonium craticulatum*, Fabr.

"Porcupine" Expedition, 1870, Stations 50, 50a; Capo de Gata, 40–69 fathoms; Adventure Bank, 30–92 fathoms.

Distribution.—Mediterranean.

FUSUS PULCHELLUS, Philippi.

Fusus pulchellus, Philippi, Moll. Sicil., ii, p. 178; Kobelt, loc. cit., i, p. 55.

"Porcupine" Expedition, 1870, Capo de Gata, 40–69 fathoms.

Distribution.—Mediterranean to (probably) Spain and Portugal. Fossil in Pliocene.

Also in the Museum as from Station 58, 1869.

FUSUS ROSTRATUS (Olivi).

Murex rostratus, Olivi, Zool. Adriat., p. 153.

Fusus rostratus, Olivi: Kobelt, loc. cit., i, p. 52.

"Porcupine" Expedition, 1870, Stations 50, 56; Adventure Bank, 92 fathoms; Benzert Road, 40–65 fathoms; Rasel Amoush, 45 fathoms.

Distribution.—Mediterranean to Canaries. Fossil from the Miocene.

FUSUS SYRACUSANUS (Linné).

Murex Syracusanus, Linné, Syst. Nat., 12th ed., p. 1224.

Fusus Syracusanus, Linné: Kobelt, loc. cit., i, p. 50.

"Porcupine" Expedition, 1870, Stations 50, 56; Capo de Gata, 40–69 fathoms.

Distribution.—Mediterranean and to Canaries. Fossil from the Miocene.

FASCIOLARIA LIGNARIA (Linné).

Murex lignarius, Linné, Syst. Nat., 12th ed., p. 1224.

Fasciolaria lignaria, Linné: Kobelt, loc. cit., i, p. 47.

“Porcupine” Expedition, 1870, Station 10 (a fragment).

Distribution.—Mediterranean. A Pliocene fossil.

MEYERIA ALBELLA (Dunker & Metzger).

Tritonium pusillum, M. Sars, Vid. Selsk. Verh. Christ., 1858, p. 79 (*nomen*).

Meyeria pusilla, Sars, Locard, Expéd. Trav. Talisman, i, p. 336.

Latirus albus, Jeffreys: Depths of the Sea, p. 464 (nom. and fig.).

Lathyrus albellus, Dunker & Metzger, Nachrbl. Deutsch. Mal. Ges., 1874, p. 11.

Meyeria alba, Jeffreys: Kobelt, loc. cit., i, p. 31.

“Porcupine” Expedition, 1869 (three specimens in one box bearing four localities).

Distribution. North Atlantic to Azores.

KRYPTOS ELEGANS (Jeffreys), Dautz. & Fisch.

Kryptos elegans (Jeffreys), Dautzenberg & Fischer, Mém. Soc. Zool. France, ix, p. 435; Kobelt, loc. cit., iii, p. 281.

“Porcupine” Expedition, 1870, Stations 16, 17, 17a, 24, 30.

Distribution.—Middle Atlantic Ocean and Azores.

The systematic position of this form remains uncertain; all the specimens I have seen are very immature. It is not the *Fusus amblyterus*, Watson.

NEPTUNEA ANTIQUA (Linné).

Neptunea antiqua, Linné: Kobelt, Icon. Europ. Meeresconch., i, p. 63.

“Porcupine” Expedition, 1869, Station 70 (one young, alive).

Distribution.—Arctic seas to the Channel Islands and the French coasts.

NEPTUNEA CONTRARIA (Linné).

Neptunea contraria, Linné: Kobelt, Icon. Europ. Meeresconch., i, p. 65.

“Porcupine” Expedition, 1870, Station 58 (a fragment).

Distribution.—Portuguese, Spanish, and French coasts, the occurrence in the Mediterranean off Sicily being doubtful (Kobelt). A Pliocene fossil. Mr. Marshall adds Station 13, but I cannot trace the specimen.

NEPTUNEA DESPECTA (Linné).

Neptunea despecta, Linné: Kobelt, Icon. Europ. Meeresconch., i, p. 63.

“Porcupine” Expedition, 1869, Station 11 (live).

Distribution.—Arctic seas to the British Isles (in deep water). A Pliocene fossil.

The box in the Museum is labelled “W. of Ireland, 85–110 fath., St. 1, 11”. The depth would fit Station 1, but not Station 11;

however, as an examination of Jeffreys' notebook yields a note of the species under Station 11 and not Station 1, I have followed him.

NEPTUNEA (SIPHO) ATTENUATA (Jeffreys).

Fusus attenuatus, Jeffreys, Proc. Roy. Soc., xviii, p. 434, 1870 (nom. sol.); Ann. Nat. Hist., xix, p. 326, April, 1877.

Neptunea attenuata, Jeffreys: Kobelt, Icon. Europ. Meeresconch., i, p. 78.

"Porcupine" Expedition, 1869, Stations 20, 28, 30, 43.



Distribution.—Also N. Norway (Sars), and a few deep-sea localities in the Atlantic.

I have found the "Porcupine" specimen to which Jeffreys refers in his original description, and now give a figure of it, as those I have seen are unsatisfactory. The references are as quoted above, and not as given by Kobelt.

NEPTUNEA (SIPHO) DALLI, Friele.

Neptunea Dalli, Friele, Norske Nordhavs Exped., Buccinidæ, p. 19.

"Porcupine" Expedition, 1869, Stations 64, 65.

Distribution.—Northern Atlantic, in deep water.

I have followed Jeffreys' identification; the species is unknown to me.

NEPTUNEA (SIPHO) EBUR (Mörch).

Siphonorbis ebur, Mörch, Journ. de Conch., p. 398, 1869.

Fusus Sarsii, Jeffreys, Nature, Dec. 9, 1869; "Depths of the Sea," p. 464, 1873.

Neptunea Sarsii, Jeffreys: Kobelt, Icon. Europ. Meeresconch., i, p. 79.

"Porcupine" Expedition, 1869, Stations 54, 65.

Distribution.—Northern seas to the British Isles. Recorded as fossil in the Red Crag.

The following interesting notes, bearing on the specific position of this species, occur in Jeffreys' MSS. They are headed "From Professor Steenstrup, 8th April, 1879; types of *Fusus ebur*, Mörch, *F. togatus*, Mörch, and *F. Pfaffi*, Mörch". From this I infer that Jeffreys had borrowed these shells.

"Closely and carefully compared all these typical specimens (having Mörch's names in his handwriting) with specimens of *F. Sabini* (Gray) from Spitzbergen, the Norwegian Arctic Expedition of 1877 (off Jan Mayen Island, Friele), and the 'Porcupine' and the 'Valorous' Expeditions. All these specimens [i.e. *ebur*, *togatus*, and *Pfaffi*, E. R. S.] certainly belong to one and the same species. In the specimen of *F. ebur* (a dead shell) the epidermis is wanting, except a few very small traces. In *F. togatus* there are a few fragments of the epidermis close to the sutures; and this epidermis is quite similar to that of *F. Pfaffi*, which is well covered. *F. ebur* is the largest shell. Epidermis ciliated.

"*F. tortuosus*, of Reeve, judging from the typical specimen, is somewhat different, being more slender and having the canal curved; the epidermis is smooth. But it may be a variety of *F. Sabini*."

Jeffreys also says, "Herr Friele, in his excellent monograph on the Buccinidæ from the Vöringen Expedition, says that I regarded this species to be the same as my *F. curtus*. This is not quite correct. I believed *F. ebur* of Mörch might be synonymous with *F. Sarsii*, which Friele assigned to my *F. curtus*. The two latter species I have always considered distinct."

NEPTUNEA (SIPHO) FUSIFORMIS (Broderip).

Buccinum fusiforme, Broderip, Zool. Journ., v, p. 45, 1829.

Neptunea fusiformis, Broderip: Kobelt, Icon. Europ. Meeresconch., i, p. 86.

"Porcupine" Expedition, 1869, Stations 4, 6, 9, 36, 45a, 78, 89; 1870, Stations 8, 9, 11, 13, 16.

Distribution.—From Northern seas to the Spanish coasts, generally in fairly deep water.

Jeffreys gives the following account of the animal of a specimen dredged on the 3rd of June, 1869, at Station 6:—"Body light brownish-yellow; pallial tube rather short, tinged with purple blotches; tentacles conical and short; eyes very small, seated on stalks about half-way up the tentacles; foot thick, streaked near the opercular lobe with purplish-brown, rounded in front with slight auricles, squarish behind, equally broad throughout. Active and not at all shy."

NEPTUNEA (SIPHO) GRACILIS (Da Costa).

Buccinum gracile, Da Costa, Brit. Conch., p. 124.

Neptunea gracilis, Da Costa: Kobelt, Icon. Europ. Meeresconch., i, p. 72.

"Porcupine" Expedition, 1869, Stations 12, 35, 45a; 1870, Station 13 (dead and very young).

Distribution.—North Atlantic to the Bay of Biscay. A post-Tertiary fossil.

NEPTUNEA (SIPHO) ISLANDICA (Chemnitz).

Fusus Islandicus, Chemnitz, Conch. Cab., iv, p. 159, pl. cxli, figs. 1312, 1313.

Neptunea Islandica, Chemnitz: Kobelt, Icon. Europ. Meeresconch., i, p. 71.

"Porcupine" Expedition, 1869, Stations 10, 84; 1870, Station 13.

Distribution.—Arctic seas and deep water in the North Atlantic.

NEPTUNEA (SIPHO) JEFFREYSIANA (Fischer).

Fusus Jeffreysianus, Fischer, J. Conchyl., xvi, p. 37, 1868.

Neptunea Jeffreysiana, Fischer: Kobelt, Icon. Europ. Meeresconch., i, p. 75.

Fusus buccinatus, Jeffreys, non Lamarck.

"Porcupine" Expedition, 1869, Station 10; 1870, Station 30.

Distribution.—British Isles to the Bay of Biscay.

NEPTUNEA (SIPHO) LACHESIS (Mörch).

Fusus lachesis, Mörch, J. Conchyl., xvii, p. 397, 1869.

Neptunea lachesis, Mörch: Kobelt, Icon. Europ. Meeresconch., i, p. 83.

Tritonium terebrales, Sars MS. [non *Neptunea terebralis*, Gould, of which *N. Spitzbergensis*, Rve., is a synonym].

Non *Fusus lachesis*, E. Sismonda, Syn., 2nd ed., p. 38, 1847 [nom. sol.]; D'Orbigny, Prodrôme, iii, p. 68, 1852 [nom. sol.]; Bellardi, Moll. Terz. Piemonte, i, 138, 1872 [deser. and fig.].

"Porcupine" Expedition, 1869, Station 51.

Distribution.—North Atlantic.

Inasmuch as *Fusus lachesis*, Sism., remained a mere name until the description by Bellardi in 1872, I have not thought it necessary to rename this species.

Very young specimens are also in the Museum as from Station 62, but I cannot confirm this locality, the depth given being erroneous.

Distinct from the present species, but identical with one another, are, I think, *Fusus Spitzbergensis*, Rve., and *F. terebralis*, Gould.

NEPTUNEA (SIPHO) PERTENUIS, n.sp.

Shell elongately fusiform, thin, fragile, very pale yellowish-white; whorls 7, rather convex, moderately increasing; protoconch smooth, on the second whorl very numerous fine spirals appear, being crossed up to the fifth whorl by obsolete longitudinal riblets, these latter gradually fade out and the last whorl is sculptured only by the densely set, irregular spirals; mouth drawn out, the canal being moderately long and rather widely open. Alt. 27.5, diam. 10 mm.

"Porcupine" Expedition, 1869, Station 51 (one live specimen); also a variety (one specimen) from Station 65.

The type was marked by Jeffreys as 'n.sp.'; but he had not drawn up any diagnosis. It seems to be nearest to *N. latericeus*, Möller, but



has more rapidly increasing whorls, the canal is more widely open, and the spirals are finer and more numerous.

NEPTUNEA (SIPHO) PROPINQUA (Alder).

Fusus propinquus, Alder, Cat. Moll. Northumb. Durham, p. 63 (Trans. Tyneside Club).

Neptunea propinqua, Alder: Kobelt, Icon. Europ. Meeresconch., i, p. 76.

"Porcupine" Expedition, 1869, Stations 15, 17, 18, 24, 30, 68, 70.

Distribution.—From Greenland south to the British Isles.

A Pliocene and post-Tertiary fossil.

Mr. Marshall notes: "In the report of the 'Valorous' Expedition, Jeffreys mistakenly recorded this species from 'Bay of Biscay, 109–1380 f.', in the 'Porcupine' Expedition of 1870, instead of from West of Ireland, Stations 24 and 30, in the expedition of 1869. Canon Norman has also recorded it from 'N. of Hebrides, 189–530 f., Porcupine Exp., 1869', instead of 'Lightning' Expedition, 1868."

NEPTUNEA (SIPHO) PUPULA (Fischer).

Fusus pupula, Fischer, Journ. de Conch., p. 274, 1882.

"Porcupine" Expedition.

A box in the Museum, named *pupula*, contains three shells (two adult), and is labelled "9, 6, 165 fath., 90 fath. 1870". Assuming that the young shell is the same as the others, we may also refer here a shell from Station 3, I am not sure of which cruise. Reverting to the former label, these stations were, from their depths, in the cruise of 1869, while Jeffreys in his MS. says the species came from the cruise of 1870. All one can really say is that this species was found during one of the cruises.

NEPTUNEA (SIPHO) SABINI (Gray).

Buccinum Sabini, Gray, Supp. and App. Parry's First Voyage, p. cxl, 1824.

Fusus Sabini, Gray: Jeffreys, Ann. Nat. Hist., vol. xix, p. 327, 1877.

"Porcupine" Expedition, 1869, Stations 11, 13; 1870, Stations 13, 22.

The above station numbers are due to Mr. Marshall. See notes under *N. ebur* (Möreh).

NEPTUNEA (SIPHO) TURGIDULA (Jeffreys), Friele.

Fusus turgidulus, Jeffreys: Friele, *Nyt. Mag. Naturv.*, p. 8, 1877.

Neptunea turgidula, Jeffreys: Kobelt, *Icon. Europ. Meeresconch.*, i, p. 74.

"Porcupine" Expedition, 1869, Stations 65, 74, 75, 78 (young), 84.

Distribution.—North Atlantic.

The stations are taken from the Museum boxes, and Nos. 65 and 84 are confirmed by Mr. Marshall's notes. Jeffreys suggests that *N. Hanseni*, Friele, may be a variety.

NEPTUNEA (MOHNI) MOHNI (Friele).

Fusus Mohni, Friele, *Nyt. Mag. Naturv.*, xxiii, p. 6, 1877.

Neptunea Mohni, Friele: Kobelt, *Icon. Europ. Meeresconch.*, i, p. 90.

"Porcupine" Expedition, 1869, Stations 62, 64.

Distribution.—Arctic seas, and south to the British Isles, in deep water.

NEPTUNEA (VOLUTOPSIS) NORVEGICA (Chemnitz).

Strombus Norvegicus, Chemnitz, *Conch. Cab.*, xi, p. 218.

Neptunea Norvegica, Chemnitz: Kobelt, *Icon. Europ. Meeresconch.*, i, p. 66.

"Porcupine" Expedition, 1869, Station 68 (live).

Distribution.—Arctic and North Atlantic seas, North America (Jeffreys). A Pliocene fossil.

TROSCHELIA BERNICIENSIS (King).

Fusus Berniciensis, King, *Ann. Nat. Hist.*, xviii, p. 246.

Troschelia Berniciensis, King: Kobelt, *Icon. Europ. Meeresconch.*, i, p. 59.

"Porcupine" Expedition, 1869, Stations 6 (fragments), 14 (fragments), 25 (egg-capsules), 39, 57, 68, 74, 78, 84; 1870, Stations 3, 8, 9.

Distribution.—Northern seas. It has been suggested that the species is circumpolar, but this needs confirmation.

LIOMESUS DALEI (Sowerby).

Buccinum Dalei, Sowerby, *Min. Conch.*, v, p. 139, pl. cccclxxxvi, figs. 1, 2.

Buccinopsis Dalei, Sowerby: Kobelt, *Icon. Europ. Meeresconch.*, ii, p. 116.

"Porcupine" Expedition, 1869, Stations 7, 10, 45a-b, 52.

Distribution.—North Atlantic. A Pliocene fossil.

BUCCINUM FINMARKIANUM, Verkrüzen.

Buccinum Finmarkianum, Verkrüzen, *Jahrb. Deutsch. Mal. Ges.*, ii, p. 237; Kobelt, *loc. cit.*, i, p. 103.

"Porcupine" Expedition, 1869, Station 65 (young, but live).

Distribution.—Northern Atlantic.

I have accepted the identification by Jeffreys in the Museum.

BUCCINUM GRÆNLANDICUM, Chemnitz.

Buccinum Grænladicum, Chemnitz, Conch. Cab., x, p. 182; Kobelt, loc. cit., i, p. 112.

“Porcupine” Expedition, 1869, Station 65.

Distribution.—Arctic seas in both hemispheres. A Pliocene fossil.

Jeffreys records his specimens as var. *glabra*, and gives the following, which I take to be a description of a new variety: “Thin, glassy, and smooth, with the exception of fine spiral striæ on the upper whorls, which afterwards disappear and are replaced by a few and indistinct ridge-like lines.”

BUCCINUM HUMPHREYSIANUM, Bennett.

Buccinum Humphreysianum, Bennett, Zool. Journ., i, p. 398; Kobelt, loc. cit., i, p. 102.

“Porcupine” Expedition, 1869, Stations 1, 6, 8, 45a-b.

Distribution.—Finmark to Bantry Bay.

According to Jeffreys “*B. nivale* of Friele is the young of the variety *lactea*”.

BUCCINUM VENTRICOSUM, Kiener.

Buccinum ventricosum, Kiener, Coq. Viv., *Buccinum*, p. 4.

Buccinum fusiforme, Kiener: Kobelt, loc. cit., i, p. 101.

“Porcupine” Expedition, 1870, Station 30 (fragment).

Distribution.—Atlantic off Spain, etc., and in Mediterranean.

I have followed Jeffreys in the name adopted for this form, and his final view as to its specific rank.

BUCCINUM UNDATUM, Linné.

Buccinum undatum, Linné, Syst. Nat., 12th ed., p. 1204; Kobelt, loc. cit., i, p. 99.

“Porcupine” Expedition, 1869, Stations 1 (var. *Zetlandica*), 2 (var. *flexuosa*), 6 (var. *Zetlandica*), 7, 8, 11 (of a conical shape, rather strong, without longitudinal ribs, closely and finely striated transversely or spirally), 25 (var. *Zetlandica*), 45a-b (conical variety), 68 and 69 (var. *Zetlandica*); Lough Foyle; near Belfast; off Lerwick (var. *Zetlandica*).

Distribution.—From Arctic seas, south to Gulf of Lyons; also on American coasts. A Pliocene fossil.

“BUCCINUM OBLITUM, n.sp.

“Shell oval, rather solid, opaque and somewhat glossy. Sculpture: several curved and flexuous longitudinal ribs on the last or body whorl, which are crossed by about as many spiral ridges, so as to give a cancellated or decussated appearance; each of the upper whorls (except those forming the apex, which are smooth) has also two or three of the same spiral ridges; the whole intermediate surface is covered with numerous fine and close-set spiral striæ; the points of intersection between the ribs and ridges are more or less nodulous;

colour pale yellowish-white; epidermis none; spire short; whorls 5-6, moderately convex; the last occupies three-fourths of the shell with the mouth placed upwards; the two upper whorls which compose the apex cylindrical and twisted; suture deepish; mouth oval and expanded, angulated above; length about three-fifths of the spire; canal very short, open, and truncated; outer lip semicircular, reflected, and having a thickened edge; inside slightly grooved in the direction of the spiral ridges; inner lip broad and glazed; pillar strong and flexuous. L. 1, B. 0.7 inch.

"'Porcupine' Expedition, 1869, Station 65.



"Six dead specimens. In one of them the longitudinal ribs are wanting; it has stronger spiral ridges, and is smaller than the other specimens.

"This species was figured in Sir Wyville Thomson's *Depths of the Sea* (1873), p. 463, fig. 76, under my name of *Buccinopsis striata*. As the operculum of the present species is not known, it is more than questionable whether it can be placed in *Buccinopsis*, and I must provisionally leave it in *Buccinum*. It may be allied to *B. abyssorum* of Verrill, as well as to *B. Baerii* of Middendorff."

The above is taken verbatim from Jeffreys' MS., save that I have changed the name he gave, his being already in use.

PURPURA LAPILLUS (Linné).

Buccinum lapillus, Linné, Syst. Nat., 12th ed., p. 1202.

Purpura lapillus, Linné: Kobelt, loc. cit., i, p. 36.

"Porcupine" Expedition, 1869, Donegal Bay, 25-40 fathoms; 1870, Vigo Bay, 20 fathoms.

Distribution.—North Atlantic from Arctic seas to Mogador. The Mediterranean records are dubious. A Pliocene fossil.

PISANIA MACULOSA (Lamarck).

Buccinum maculosum, Lamarck, Anim. sans Vert., vii, p. 269.

Pisania maculosa, Lamarck: Kobelt, Icon. Europ. Meeresconch., i, p. 93.

"Porcupine" Expedition, 1870, Gibraltar.

Distribution.—Mediterranean; the Atlantic records are doubtful. Fossil in Miocene of S. Europe.

EUTHRIA CORNEA (Linné).

Murex corneus, Linné, Syst. Nat., 12th ed., p. 1224.

Euthria cornea, Linné: Kobelt, Icon. Europ. Meeresconch., i, p. 118.

"Porcupine" Expedition, 1870, Capo de Gata, 40-69 fathoms.

Distribution.—Generally throughout the Mediterranean. Fossil since the Miocene.

NASSA CORNICULUM (Olivi).

Buccinum corniculum, Olivi, Zool. Adriat., p. 144.

Nassa corniculum, Olivi: Kobelt, loc. cit., i, p. 158.

“Porcupine” Expedition, 1870, Station 50; Benzert Road, 40–65 fathoms.

Distribution.—Throughout the Mediterranean. A Miocene fossil.

NASSA INCRASSATA (Ström).

Buccinum incrassatum, Ström, Königl. Norsk. Vid. Selsk. Skr., iv, p. 369.

Nassa incrassata, Ström: Kobelt, loc. cit., i, p. 152.

“Porcupine” Expedition, 1869, Lough Foyle, 10 fathoms; “Bundoran,” spawn; “C. Sagres”; 1870, Station 50.

Distribution.—Atlantic and Mediterranean. A Tertiary fossil.

NASSA LIMATA (Chemnitz).

Buccinum lima seu limatum, Chemnitz, Conch. Cab., xi, p. 87, pl. clxxxviii, figs. 1808, 1809.

Nassa limata, Chemnitz: Kobelt, loc. cit., i, p. 140.

“Porcupine” Expedition, 1870, Stations 50, 51, 56; Adventure Bank, 92 fathoms; Benzert Road, 40–65 fathoms.

Distribution.—Mediterranean seas and to Azores. A Miocene fossil.

NASSA MUTABILIS (Linné).

Buccinum mutabile, Linné, Syst. Nat., 12th ed., p. 1201.

Nassa mutabilis, Linné: Kobelt, loc. cit., i, p. 122.

“Porcupine” Expedition, 1870, Station 50.

Distribution.—Mediterranean to Azores and West Africa. A Miocene fossil.

NASSA PRISMATICA (Brocchi).

Buccinum prismaticum, Brocchi, Conch. Foss. Subapp., ii, p. 337.

“Porcupine” Expedition, 1870, off Cape Sagres, 45–58 fathoms; Rasel Amoush, 45 fathoms; Benzert Road, 40–65 fathoms.

I have kept the records made by Jeffreys distinct from those of *Nassa limata*. Dr. Kobelt is of opinion that the two forms are identical.

NASSA PYGMÆA (Lamarek).

Ranella pygmæa, Lamarek, Anim. sans Vert., vii, p. 154.

Nassa varicosa, Turton: Kobelt, loc. cit., i, p. 156.

“Porcupine” Expedition, 1870, Benzert Road, 40–65 fathoms.

Distribution.—Atlantic and Mediterranean. A Tertiary fossil.

Dr. Kobelt states, but gives no reference, that there is a prior *N. pygmæa* of Schlotheim. In Jeffreys' MS. occurs the following: “In the Bull. Mal. Ital. for 1870, Weinkauff states that Schlotheim had anticipated Lamarek in using the name *pygmæa* for a fossil species of *Nassa*. I have examined the work of Schlotheim referred to

(Beiträge zur Naturgeschichte der Versteinerungen in geognostischer Hinsicht), being an article in the Proceedings of the Royal Academy of Sciences at Munich for the year 1816 and 1817; but I failed to find either in the text or plates any such fossil as *Muricites pygmaeus*."

NASSA RETICULATA (Linné).

Buccinum reticulatum, Linné, Syst. Nat., 12th ed., p. 1204.

Nassa reticulata, Linné: Kobelt, loc. cit., i, p. 135.

"Porcupine" Expedition, 1869, Lough Swilly, 3-13 fathoms (spawn); 1870, "Cadiz"; Vigo Bay, 20 fathoms.

Distribution.—Throughout the Mediterranean and in the North Atlantic. A Pliocene fossil.

NASSA SEMISTRIATA (Brocchi).

Buccinum semistriatum, Brocchi, Conch. Foss. Subapp., p. 651.

Nassa semistriata, Brocchi: Kobelt, loc. cit., i, p. 131.

"Porcupine" Expedition, 1870, Stations 10, 53; Vigo Bay; Cape Sagres.

Distribution.—Lusitanian and Mediterranean Seas. A Miocene fossil.

Jeffreys describes the animal of a specimen from Station 10 as follows:—"Body pale orange. Siphonal sheath or tube light brown. Tentacles long, slender, and tapering. Eyes small, above the base of tentacles. Foot broad in front and expanded into two longish auricles or triangular points; extremity or hinder part pointed; caudal filaments remarkably long and separate. Spawned in the glass vessel. The spawn was free or loose and not inclosed in any capsule or case."

CYCLONASSA NERITEA (Linné).

Buccinum neriteum, Linné, Syst. Nat., 12th ed., p. 1201.

Cyclonassa neritea, Linné: Kobelt, loc. cit., i, p. 163.

"Porcupine" Expedition, 1870, "Tunis."

Distribution.—Mediterranean and Lusitanian Seas. A Pliocene fossil.

Amongst Jeffreys' notes is a letter from David Robertson, dated 1878, giving an account of two specimens of this shell "taken from the crop of the Ice-Duck (*Heralda glacialis*)", killed in Skye.

COLUMBELLA, Lamarek.

In Jeffreys' MS. occur also the names of *Columbella scripta*, Linné, and *C. minor*, Sc.; but he has not inserted any station numbers, and I cannot trace the specimens.

COLUMBELLA HIDALGOI (Monterosato).

Mitrella Hidalgoi, Monterosato, Journ. Conchyl., xxxvii, p. 116, 1889;

Kobelt, loc. cit., iv, p. 152.

"Porcupine" Expedition, 1870, Station 30.

Distribution.—Mediterranean.

COLUMBELLA RUSTICA (Linné).

Voluta rustica, Linné, Syst. Nat., 12th ed., p. 1190.

Columbella rustica, Linné: Kobelt, loc. cit., ii, p. 30.

"Porcupine" Expedition, 1870, "Cadiz" (Brit. Mus.).

Distribution.—Mediterranean and Atlantic. A Pliocene fossil.

PYRENE COSTULATA (Cantraine).

Fusus costulatus, Cantraine, Diagn. Succ., p. 20.

Pyrene costulata, Cantraine: Kobelt, loc. cit., ii, p. 33.

Columbella haliæti, Jeffreys.

"Porcupine" Expedition, 1869, Stations 10, 13, 17, 36, 42, 65; 1870, Stations 16, 51, 56; Cape Sagres, 45–58 fathoms; Adventure Bank, 92 fathoms.

Distribution.—Deep water in Atlantic and Mediterranean. Fossil in Pliocene.

I have followed Dr. Kobelt. Jeffreys notes: "The type of *Fusus costulatus* seems to have disappeared, but the description would suit *P. striolata* of Scacchi. I therefore retain the specific name which I gave to the present species."

TROPHON (?) COSTIFERUM, S. Wood.

Trophon costiferum, S. Wood, Crag Moll., p. 48, pl. vi, fig. 9.

"Porcupine" Expedition, 1870, Station 13.

Identified by Mr. Marshall.

TROPHON MULTILAMELLOSUS (Philippi).

Murex multilamellosus, Philippi, Enum. Moll. Sicil., p. 182.

Trophon multilamellosus, Philippi: Kobelt, Icon. Europ. Meeresconch., i, p. 29.

"Porcupine" Expedition, 1870, Stations 30, 51; Rasel Amoush, 45 fathoms.

Distribution.—Deep sea in the Mediterranean and off North Spain. A Pliocene fossil.

TROPHON VAGINATUS (Cristofori & Jan).

Murex vaginatus, Cristofori & Jan, Cat., p. 11.

Trophon vaginatus, C. & J.: Kobelt, loc. cit., i, 29.

"Porcupine" Expedition, 1870, Stations 13, 30, 50, 56; Adventure Bank, 92 fathoms.

Distribution.—Deep water in the Mediterranean and Atlantic. A Miocene fossil.

Several other station numbers appear on the Museum boxes, but I am unable to verify them.

Jeffreys gives the following description of the animal of a specimen from Station 13: "Body cream colour. Siphonal sheath short beyond the canal. Tentacles short, cylindrical above the eye-stalks. Eyes small, black. Foot thick, short, and broad; truncated in front and rounded behind."

TROPHONOPSIS CLATHRATUS (Linné).

Murex clathratus, Linné, Syst. Nat., 12th ed., p. 1223.

Trophon clathratus, Linné: Kobelt, loc. cit., i, p. 25.

"Porcupine" Expedition, 1869, Stations 10, 59, 65; Dingle Bay; Lough Foyle.

Distribution.—Arctic seas to North Atlantic. Fossil in Pliocene. The specimens from Lough Foyle and Dingle Bay belong to the var. *truncata*.

TROPHONOPSIS MURICATUS (Montagu).

Murex muricatus, Montagu, Test. Brit., i, p. 262.

Trophon muricatus, Montagu: Kobelt, Icon. Europ. Meeresconch., i, p. 30.

"Porcupine" Expedition, 1869, Dingle Bay (J. T. Marshall).

Distribution.—North Atlantic to Mediterranean. A Pliocene fossil.

There are a number of boxes in the Museum, but the stations and depths are in confusion. As bearing on Dr. Kobelt's remarks (loc. cit., pp. 31, 56) as to *Fusus longurio*, Weinkauff, I may say that Jeffreys notes that this latter form is identical, adding "ex typ."

TROPHONOPSIS BARVICENSIS (Johnston).

Murex Barvicensis, Johnston, Edinb. Phil. Journ., xiii, p. 225.

Trophon Barvicensis, Johnston: Kobelt, Icon. Europ. Meeresconch., i, p. 28.

"Porcupine" Expedition, 1869, Stations 9, 14, 23a; 1870, Stations 30, 50, 56; Adventure Bank, 92 fathoms.

Distribution.—North Atlantic and Mediterranean. A Pliocene fossil.

CORALLIOPHILA LAMELLOSA (Jan).

Fusus lamellosus, Jan, Cat. Rer. Nat., p. 10.

Coralliophila lamellosa, Jan: Kobelt, loc. cit., i, p. 41.

"Porcupine" Expedition, 1870, Station 50.

Distribution.—Mediterranean; the records beyond need confirmation.

Also a young specimen from Station 24, of which Mr. Marshall says "The Marquis de Monterosato suggests may be fossil".

CORALLIOPHILA MEYENDORFFII (Calcara).

Murex Meyendorffii, Calcara, Moll. Viv. Foss. Sicil., p. 38.

Coralliophila Meyendorffii, Calcara: Kobelt, loc. cit., i, p. 40.

"Porcupine" Expedition, 1870, Station 50.

Distribution.—Mediterranean to the Canaries.

MUREX.

The names of several species occur in Jeffreys' MSS., but unfortunately he has not inserted the station numbers, and I am unable to trace any of them in the Museum collection.

MUREX CRISTATUS, Brocchi.

Murex cristatus, Brocchi, Conch. Foss. Subapp., p. 394; Kobelt, loc. cit., i, p. 14.

“Porcupine” Expedition, 1870, Adventure Bank, 92 fathoms.

Distribution.—Mediterranean and to Senegal. Fossil in the Miocene.

MUREX FUSULUS, Brocchi (?).

Murex fusulus, Brocchi, Conch. Foss. Subapp., ii, p. 409; Kobelt, loc. cit., i, p. 165.

“Porcupine” Expedition, 1870, Station 56.

Distribution.—Mediterranean and to the Azores, etc.

A young specimen, of which the identity is not quite certain (J. T. Marshall).

SOME REMARKS ON THE NOMENCLATURE OF THE VENERIDÆ.

By Dr. W. H. DALL.

Read 12th May, 1911.

THE March number of the Proceedings of the Society contains an extended criticism of the nomenclature adopted by me in my revision of the Veneridæ. The author, Mr. Jukes-Browne, in more than one paper has shown that his idea of the relation of species is largely based on superficial characters, such as sculpture, a view which I do not share and in which Bolten, whom he criticizes severely without consideration for the different state of science in 1798, was his precursor.

Mr. Jukes-Browne's opinions on settled questions may be passed without remark. In some other matters it is perhaps well that I should explain the principles which led me to certain conclusions, for the sake of those who do not care to explore the archæology of the subject.

In the matter of the selection of a type for a genus in the case of those authors who did not specify a species as typical, the final paragraph, rule 30, cited by Mr. Jukes-Browne, is not the only rule applicable to the matter. In genera proposed with only one species (monotypical) that species necessarily becomes the type whether designated as a type or not, and on this basis I have regarded the species cited in Lamarck's Prodrôme of 1799 as typical of the genera accepted or proposed by him in that publication. *Venus*, Lamarck, 1799, is typified by *V. mercenaria*, L., no matter what views Linnæus or Lamarck may have privately held before or after that publication. And if *Venus*, Linné, contained that species, and no type had been selected before that 1799 publication, *V. mercenaria* becomes, *ipso facto*, the type of *Venus* (L.), Lam. This is the view I have taken, and, while it may not be universally accepted, my work must be criticized, if at all justly, on that basis.

Mr. Jukes-Browne objects to the acceptance of the monotypical genus, yet later he argues for the acceptance of *Gafrarium*, H. and A. Adams, who designated no type and listed alphabetically five species.

Mr. Jukes-Browne classes Bolten's genera as merely "arbitrary assemblages not distinguishable from one another by any common generic characters", which seems to me, taking the state of science at the time into account, a misrepresentation of the facts. It is true Bolten, with more excuse than his critic, based his genera largely on surface characters and external form; nevertheless, his classification was far in advance of his time.

In proposing to unite *Protothaca* with *Chione*, my critic ignores the anatomical differences, pallial sinus, the character of the hinge, and everything except the more or less (generally less) reticulate surface-sculpture.

In the discussion of the name *Paphia*, Bolten, I found Bolten's,

catalogue of species to contain seven species of *Tapes* (*sensu lato*), one *Sunetta*, and one *Meretrix* (in the sense of Lamarck, = *Cytherea*). As seven-ninths of the species thus belonged to one group I felt that I was giving better expression to Bolten's idea of the genus by selecting a type from one of the seven than by taking the one discrepant form which headed the list, a *Meretrix* (Lam.) in the original sense, as I correctly (and not by any mistake) stated. I retained *Tapes*, Megerle, in a subgeneric sense for the species for which it has been most commonly used, and therefore the 'displacement' complained of by my critic does not exist, and Megerle is not, as Mr. Jukes-Browne erroneously supposes, deprived of the right to the perpetuation of his name. The same results, however, would follow if Mr. Jukes-Browne's views of the nomenclature of *Cuneus*, Da Costa, were accepted, though he stops short of stating it.

In the case of *Pectunculus*, Da Costa, repugnant as it seems to revive a name used by many authors in different senses and not in the original sense of the Cockles (*Trachycardium*) to which the ancients gave it, it is probable that it should, following the rules strictly, be retained, and the best disposition of it perhaps would have been to adopt Da Costa's first species, formerly known as *Cyprina Islandica*, as the type. This species has been so many times renamed that less trouble would be caused by its use as the type than in the case of any of the others listed by Da Costa. But Mr. Jukes-Browne's selection of *Dosinia exoleta* prevents this, and *Pectunculus* will have to be substituted for *Orbiculus*, Megerle, as a subdivision of *Dosinia*.

In the matter of *Cuneus*, Da Costa, his only generic character is that the beaks are near one end. This and the meaning of the word point to *Donax* as the kind of shell he had in mind, if, indeed, he had any clear idea at all. Gray was quite right in selecting a *Donax* for the type, only he chose the same species (*D. vittatus*, Da Costa) which served Lamarck in 1799 as his monotype of the genus *Donax*. This shell, by the way, has nothing to do with Scopoli's genus *Chion*, as wrongly supposed by Mr. Jukes-Browne. On the contrary, it belongs to *Serrula*, which Mörch validated from the non-binomial Chemnitz, who applied it to this very species.

I have already indicated that no mistake in my opinion was made in the matter of *Paphia*, Bolten. Under that head I have the entry in my synonymy "*Cuneus* (sp.), Da Costa", etc., "1778, not of Da Costa, 1776 (= *Trigonia*), nor *Cuneus*, Deshayes, 1853." The curious thing about this, as cited by Mr. Jukes-Browne, is that he leaves out the '(sp.)', thereby altering the meaning of the item. Otherwise, the entry, unmodified, simply records a fact to know which, as "*Cuneus*, Da Costa" is cited in the nomenclators as of 1776, as well as 1778, is necessary to avoid misunderstanding by those who do not look up the original.

Mörch, in reviving *Cuneus*, Da Costa, as a section of *Venus* (L.), Lam., includes *C. reticulatus*, Da Costa (= *decussatus*, L.), the only one of the Da Costa species in his list, so (as the older name) if this be accepted, it would exclude from valid nomenclature the genus *Tapes*, Megerle, the very result for which he criticizes me, having overlooked

the fact that I retain Megerle's name subgenerically; *T. litteratus*, Megerle's monotype, being at most subgenerically different from *Paphia* (*Ruditapes*) *decussata*, L. As Da Costa's first species and as the only one of his species to be mentioned under the revived name by Mörch, the latter must be taken as the type if *Cuneus* is to be retained.

If, after a selection of a type has been made under the existing rules, appeals to the Commission for a new change are to be allowed, it is evident that stability of names will never be attained.

DESCRIPTION OF A NEW SPECIES OF THE GENUS *CONUS*
FROM SOUTH AFRICA.

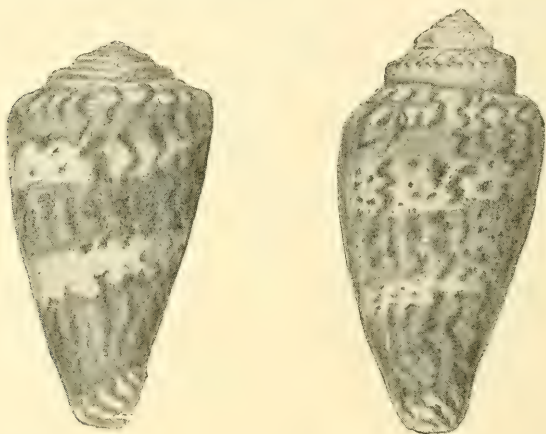
By G. B. SOWERBY, F.L.S.

Read 12th May, 1911.

CONUS BECKERI, n.sp.

Testa turbinata, mediocriter obesa, albida, luteo-fusco tribalteata, flammulis longitudinalibus saturationibus irregulariter diversiformibus ornata, maculis fuscis minutis plus minusve conspersa; spira convexa, leviter prominens; anfractus 8-9, læves, obtuse angulati, supra angulum leviter concavi; anfractus ultimus leviter convexus, basim versus attenuatus; apertura mediocriter lata. Long. 50, diam. maj. 27 mm.

Hab.—St. Francis Bay, South Africa.



A rather gaily-coloured Cone, with three rather broad bands of yellowish brown and irregularly formed flames of a darker colour. The spire in the normal form is somewhat obtuse, and but little raised, with the whorls graduated, smooth, and concave at the top. The body-whorl is slightly rounded at the angle, which, however, is fairly prominent, convex at the sides, and tapering towards the base. In addition to the colour-bands and flames the type-specimen has here and there a few minute brown spots.

The second specimen is an abnormality; its spire being considerably raised and irregularly gradate; in this the small brown spots are much more numerous.

The only two specimens I have seen of this species were submitted to me by Dr. H. Becker, of Grahamstown, after whom I have pleasure in naming it.

Dr. Becker also sent me for comparison specimens of *Conus lautus*, Reeve, from the same locality, some of the specimens bearing a slight resemblance to the new species, but differing considerably from it in form and in the character of the spire.

A MODIFICATION IN THE FORM OF SHELL (*SIPHONARIA ALGESIRÆ*, QUOY) APPARENTLY DUE TO LOCALITY.

By the Rev. A. H. COOKE, M.A.

Read 12th May, 1911.

WHEN collecting *Siphonaria Algesiræ*, Quoy, in January last, on the rocks at both sides of the entrance to the Mediterranean, I was struck with a variation in the shape of the shell, which appeared to be directly due to the nature of the station occupied.

So far as I was able to ascertain, this species occurs on rocks from low-water mark up to the highest point reached by the spray of the ordinary tide. At Tangier the normal tide-fall is about 6 feet, at Cadiz probably rather more. Specimens taken from near high-water mark at both localities showed an elevated apex, while specimens from near half-tide mark were comparatively flattened. It occurred to me to have measurements taken, (*a*) of the apical angle of a number of specimens, measuring the angle along the long axis of the shell, and (*b*) of the height of the apex, and then, after taking the length of each specimen, to obtain (*c*) a ratio of height to length. Groups of shells taken from what may be called the upper and the lower levels were thus contrasted in three points—(*a*) the apical angle, (*b*) the height of apex, (*c*) the ratio of height to length.

On the coast close to Cadiz a sort of low reef ran out into the sea at an angle of about 45° to the shore, and shelved very gradually shorewards, with a steep fall of about 2 or 3 feet on the sea side, so that the waves broke at the foot of the steep and washed shorewards over the reef. In contrast to this station were isolated blocks of rocks measuring 10 or 12 feet square, lying on the sand near high-water mark, and not habitually beaten by the waves. Both these stations abounded in *Siphonaria*. The contrast in the shape of specimens was marked, those from the reef being often so flattened as to be scarcely distinguishable from the rock on which they lived, while on the boulders near high-water mark they were elevated and bold.

SERIES I. CADIZ, FROM THE LOWER LEVEL.

Specimen. ¹	Apical angle.	Length of shell.	Height of apex.	Ratio of height to length.
A	125°	2·00	·47	·23
B	110°	1·80	·35	·19
C	130°	1·60	·30	·19
D	120°	1·70	·31	·18
E	115°	1·20	·15	·13
F	125°	1·70	·25	·15
Average	120°	1·70	·30	·18

¹ I owe all these measurements to the kindness of my friend and pupil Mr. D. W. Parkes.

SERIES II. CADIZ, FROM THE HIGHER LEVEL.

Specimen.	Apical angle.	Length of shell.	Height of apex.	Ratio of height to length.
G	90°	1·70	·60	·35
H	87°	1·65	·60	·36
I	90°	1·50	·50	·33
J	92°	2·00	·62	·31
K	91°	1·60	·48	·30
L	90°	1·90	·64	·34
Average	90°	1·70	·57	·33

Here, in the case of the specimens from the lower locality, an average apical angle of 120° is found, while in the specimens from the higher level the angle is far more acute, averaging 90°, a difference of as much as 30°; the height of the apex averages ·30 cm. in the former case and ·57 cm., or nearly twice the height, in the latter, while the ratio of height to length along the long axis is in the one case ·18 cm., or less than one-fifth, in the other as much as ·33, or nearly one-third.

Again, at Tangier, on level rocks at about half-tide, *Siphonaria* exhibits a shell which is comparatively flat and an apex which is not elevated. On the cliffs at whose foot the waves break at high tide, and where, as a rule, only the spray can reach it, the same species shows a shell which is the reverse of flat, and whose apex is prominent and elevated.

SERIES III. TANGIER, FROM THE LOWER LEVEL.

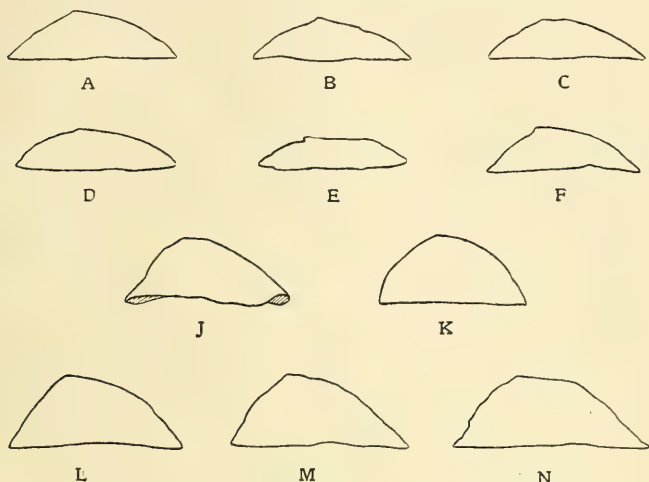
Specimen.	Apical angle.	Length of shell.	Height of apex.	Ratio of height to length.
A	106°	2·30	·55	·24
B	108°	2·10	·48	·23
C	107°	2·20	·50	·23
D	103°	2·15	·45	·20
E	107°	2·10	·38	·18
F	100°	2·15	·50	·23
G	105°	2·08	·35	·17
H	106°	1·80	·20	·11
I	101°	2·10	·45	·21
Average	105°	2·10	·43	·20

SERIES IV. TANGIER, FROM THE HIGHER LEVEL.

Specimen.	Apical angle.	Length of shell.	Height of apex.	Ratio of height to length.
J	85°	2·15	·80	·37
K	88°	2·00	·80	·40
L	88°	2·20	·81	·37
M	87°	2·30	·80	·35
N	90°	2·60	·82	·31
O	90°	2·10	·59	·28
P	83°	2·20	·87	·40
Q	88°	2·00	·70	·35
R	90°	2·10	·62	·30
Average	87·6°	2·20	·76	·35

Here, again, although the Tangier specimens from the lower level (Figs. A–F) are not so markedly flat as those from Cadiz, yet they show an average apical angle of 105°, as compared with one of 87·6° from shells taken from the high-tide mark (Figs. J–N); the height of apex in the former case averages ·43 cm., in the other ·76, or not

far from double, while the ratio of height to length is in the one case $\cdot 20$ cm., in the latter $\cdot 35$ cm., or 75 per cent higher.



The conclusion can scarcely be resisted that the flattening of the shell on the reefs towards low-water mark is an advantage to the organism, enabling it to avoid the strong impact of the waves, whose power to detach must decrease in direct ratio with the smaller amount of resistance they encounter. Given an equal capacity for 'holding on', an elevated shell would have more chance of being knocked off by the force of breaking waves than a comparatively flat shell which allowed the water to run over it. On the other hand, in a station where the impact of a wave was rarely felt, and where there was comparatively little need to provide against sudden shocks, an elevated shell would suffer no disadvantage, and would therefore tend to become the rule. The facts as observed are in direct accordance with this theory.

In a very interesting account of the common limpet Mr. E. S. Russell¹ arrives at very similar conclusions. He observes: "To sum up, adult *exposed* shells of *Patella* are lower-spined, narrower, thicker, and more irregular in outline than *sheltered* shells; and these differences are probably due to the difference of friction to which the two kinds of shells are exposed from waves and tide."

The Rev. Canon Norman² also remarks: "It will be found to be a general rule with regard to the limpet that the nearer high-water mark the shells are taken, the higher-spined, more strongly ribbed, and smaller it will be; and that the lower down it lives, the flatter, less ribbed, and larger it becomes." Mr. Russell, commenting upon this statement, says: "While my observations entirely corroborate the truth of the statement that *high-water* limpets are typically high-spined, yet I find, for one area at least, that the proportion of large shells is greater at high-water than at low-water."

¹ Proc. Zool. Soc., pp. 856-70, 1907.

² *The Zoologist*, p. 7202, 1860.

DESCRIPTION OF A NEW SPECIES OF *ACMÆA* FROM BOMBAY,
AND NOTES ON OTHER FORMS FROM THAT LOCALITY.

By EDGAR A. SMITH, I.S.O.

Read 9th June, 1911.

SPECIMENS of an *Acmaea* from Bombay have recently been presented to the British Museum by Major A. J. Peile, R.A., and as the genus has not been until recently¹ recorded as inhabiting the shores of India, it seemed desirable to give an account of the present species. Its existence at Bombay, however, has been known to me since the year 1882, when the late Dr. W. T. Blanford gave to the Museum a dozen examples. These, however, were only about half the size of those received from Major Peile.

The shores of Bombay are not very prolific in limpet-like forms such as *Patella*, *Acmaea*, etc. Messrs. Melvill & Abercrombie² enumerate the following:—

1. *Fissurella Bombayana*, Sow. = *lima*, Sow.
2. *Emarginula elongata*, Phil.
3. *E. radiata*, Gould.
4. *Scutum unguis* (Linn.).
5. *Patella aster*, Reeve.
6. *Clypidina notata* (Linn.).

No. 2. *Emarginula elongata*. Philippi never published a species under this name, but he quoted³ the Mediterranean shell described by Costa with that appellation. This is quite distinct from the shell figured by A. Adams & Sowerby as "*E. elongata*, Philippi".⁴

The specimens from Bombay thus identified have kindly been sent to me for examination by Mr. J. C. Melvill, who borrowed them from the Manchester Museum, where they were placed by Mr. Abercrombie, by whom they were collected. A careful study of them proves that they are neither the *elongata* of Costa nor of the Thesaurus, but are certainly identical with *E. dilecta*, A. Ad., originally said to be from King George's Sound, South Australia. In the Museum there are several specimens collected at Bombay by Mrs. Deakin, by whom they were presented.

The "*E. elongata*, Philippi" of the Abercrombie & Melvill list must therefore be regarded as a mere *nomen nudum*.

No. 3. The *Emarginula* (*Clypidina*) *radiata* was described by Gould from Sydney Harbour, and was supposed by Tenison-Woods to be the same species as *E. australis*, Lamk. As Lamarek never described an *E. australis*, possibly the species characterized under that name by Quoy & Gaimard was referred to.

I have not seen any specimens from Bombay, so cannot confirm the

¹ Preston, Records Indian Mus., vol. vi, p. 39, *Acmaea Travancorica*.

² Mem. Proc. Manchester Lit. Phil. Soc., ser. IV, vol. vii, p. 41, 1893.

³ Enum. Moll. Sicil., vol. i, p. 115, pl. vii, fig. 13.

⁴ Thesaurus Conch., vol. iii, p. 212, pl. 246, fig. 33.

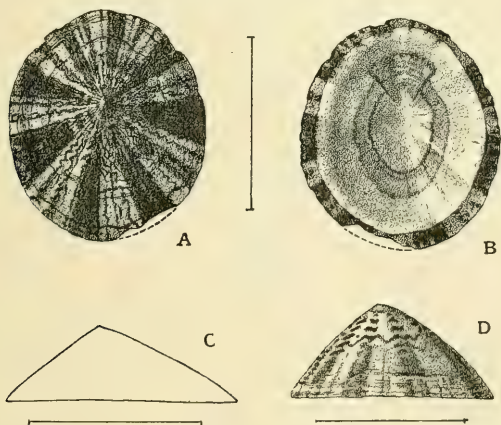
identification by Mr. Abercrombie. The species, however, should be placed in the genus *Submarginula*. It has never been figured, and without examining the type it is almost impossible to know its true relationship.

No. 5. *Patella aster*, Reeve, appears to be the only species of the genus hitherto met with at Bombay. It is variable in colour; the white rays, which are inconstant in number (although nine are often observable) are hardly visible externally in some specimens. In the type the nine rays are very striking, as the shell figured by Reeve has been much cleaned. In one example collected by Major Peile the dark rays are so broken up that the markings hardly look like radiations.

Pilsbry (Man. Conch., vol. xiii, p. 147) unites this species with the *Patella novemradiata* of Quoy & Gaimard, described from the Mauritius, but as I do not feel convinced of the certainty of the identification I prefer to name the Bombay shells *P. aster*, about which there is no doubt, since a comparison of the series of specimens collected by Major Peile proves their identity beyond question. It seems to me more likely that the Mauritian *novemradiata* may be a form of one of the African species, e.g. *rota*, Gmelin, or *capensis*, Gmelin. The animal of *P. aster* has not hitherto been studied, but an examination of the radula shows that this species belongs to the genus *Helcioniscus*, in which it is located by Pilsbry.

ACMÆA BOMBAYANA, n.sp. Figs. A-C.

Testa ovato-rotundata, mediocriter elata, vertice paulo antemediani, fusco et albo radiata, interdum minute fusco reticulata, radiatim tenuiter striata, striis incrementi tenuissimis sculpta; radii albi, sæpe



in paribus dispositi, radio fusco intermedio quam cæteris pallidiori divisi; facies interna alba, area centrali pallide olivaceo-fusca, limbo definito albo et rufo-fusco notato, haud crenulato. Long. 17.5, diam. 15, alt. 6.5 mm.

About the same form as the Bombay *Patella aster*, but differing in other respects. *Acmaea parasitica* (d'Orbigny) is a little like the present species, but rather more ovate, and "arched in every direction in consequence of attaching itself to other shells" with convex surfaces. On the contrary, all the specimens I have seen of *A. Bombayana* appear to have rested upon flat or almost level surfaces, as the margin is even and unarched all round.

The rays are generally of two shades of brown, some much darker than others, and the paler ones nearly always falling between the white rays, which frequently appear to be in pairs. In addition to the rays a fine brown and white reticulation not infrequently occurs. The fine radiating thread-like lines are only observable in well-preserved specimens. The interior is thickened with a white callus deposit, excepting the central portion, which is stained a pale livid olive and defined from the white part of the interior by a distinct horseshoe-shaped margin. The outer limbus is thin, sharply defined, and prettily marked with the ends of the brown and white rays.

Var. CEYLANICA. Fig. D.

Like the type, but a trifle more elevated, without the fine brown reticulation, but with the darker rays commencing as spots or dots near the apex. Largest specimen 19.5 mm. in length, 16 in diameter, and 9 high.

Hab.—Galle, Ceylon (H. F. Blanford).

The increased elevation of this variety is probably due to its occurrence in a more exposed position than the Bombay shells. It has been observed with regard to our common limpet, *Patella vulgata*, that specimens occurring near high-water mark, and consequently more exposed to the breaking of the waves, are higher and more conical than those found lower down on the shore.

The *Acmaea Travancorica*, Preston, has an arched lateral basal margin, is differently coloured ("pale brownish yellow with occasional blotches of dark purple"), and more roughly sculptured. The colour of the interior of the shell is not described, but it is merely said to be iridescent. The margin is described as "regularly spotted with purple". This iridescence and the apparent absence of a defined limbus or border seem to indicate that this species has more affinity to the Patellidæ than the Acmaeidæ.

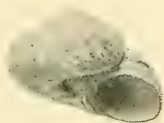
DIAGNOSES OF THREE NEW OPERCULATE LAND SHELLS FROM
GRAND CAYMAN ISLAND.

By H. B. PRESTON, F.Z.S.

Read 9th June, 1911.

NEOCYCLOTUS FONTICULUS, n.sp.

Shell rather depressedly turbinate, solid, in dead condition greyish white; whorls $4\frac{1}{2}$, rather rapidly increasing, the last descending abruptly and disjunct in front, very coarsely corrugated throughout; suture impressed, somewhat crenellate, broadly margined below,



especially on the last whorl; umbilicus surrounded above by an angular overhanging ridge, rather narrow, very deep; labrum greatly receding behind, acute, white; aperture subcircular. Alt. 10 mm.; diam. maj. 14.25, min. 11 mm. Aperture: alt. 10.5, diam. 10.5 mm.

Hab.—Grand Cayman Island.

CHOANOPOMA ROSENBERGIANUM, n.sp.

Shell somewhat thin, fusiformly turbinate, dark greyish brown; remaining whorls $3\frac{1}{2}$, convex, sculptured with very closely set, slightly oblique transverse costulae, crossed by numerous spiral lirae; suture very deeply impressed, scarcely crenellate; umbilicus narrow, deep, coarsely spirally lirate; labrum cream-coloured, continuous, laminiferous, the inner margin erect and smooth, the outer margin



moderately broadly, outwardly expanded, and somewhat bluntly serrate at the edge; aperture subcircular; interior of shell pale reddish brown; operculum calcareous, slightly concave, whitish cream-coloured, with sub-central brownish nucleus. Alt. 13 mm.; diam. maj. 10, min. 7.5 mm. Aperture: alt. 4, diam. 3.5 mm.

Hab.—Grand Cayman Island.

CHONDROPOMA CAYMANENSE, n.sp.

Shell fusiform, moderately solid, decollate, flesh-coloured; remaining whorls $4\frac{1}{2}$, somewhat convex, sculptured with coarse closely set spiral liræ and rather fine closely set transverse striæ, thus presenting a decussate appearance; suture well impressed; columella descending



in a very oblique curve; peristome continuous, double, white, the lower margin narrowly reflexed, the upper erect; aperture very obliquely ovate. Alt. 11 mm.; diam. maj. 5.5, min. 4.25 mm. Aperture: alt. 3, diam. 2 mm.

Hab.—Grand Cayman Island.

FURTHER NOTE ON PREOCCUPIED MOLLUSCAN GENERIC NAMES
AND A PROPOSED NEW GENUS OF THE FAMILY HELICIDÆ.

By G. K. GUDE, F.Z.S.

Read 9th June, 1911.

SINCE my former note on preoccupied generic names of Mollusca was printed in these "Proceedings" Mr. Ponsonby has kindly drawn my attention to the fact that Conrad created a sub-genus of *Unio* under the name of *Cœlatura* in 1853.¹ The Zonitoid genus *Cœlatura* established in 1877 by Pfeiffer² as a subsection of *Hemicycla* for the reception of *Helix cœlatura*, Fér., consequently requires a new name, and I propose to substitute *Plegma*³ for it.

While working at French Tertiary Mollusca I found that *Dactylius*, proposed as a section of *Amphidromus* by Sandberger⁴ in 1873, with *Bulimus lævolongus*, Boubée, from the Oligocene as the type, is not available in Mollusca, the name having been employed in Vermes as far back as 1839. While slightly modifying the name to *Dactylomorpha*,⁵ I propose to raise the group to generic rank, dissociating it from *Amphidromus*. The genus comprises, besides the type, three other known species, i.e. *subcylindrica*, Matheron,⁶ *Serresi*, Matheron,⁷ and *Robiacensis*, Roman.⁸

An analogous case is that of *Coryna*, Westerlund, 1887. The Swedish Professor proposed the name⁹ in lieu of *Sphyradium*, Hartmann, 1840, a section of *Pupa*, having *P. Ferrari*, Porro,¹⁰ for type (not *Sphyradium*, Charpentier, 1837). *Coryna* being preoccupied in Coleoptera (Billberg, 1813), I propose to substitute *Agardhia*, in honour of Dr. Carl Agard Westerlund.

Among the many interesting Mollusca from the Oligocene phosphate deposits of Quercy in the Department of Tarn occurs an aberrant form of Helicoid described by Bourguignat as *Helix Filholi*. While admitting that he knew no other species of *Helix* to which it bears any resemblance, he compares it with *H. gregaria*. The comparison is not, in my opinion, a happy one, as neither that species nor any of its allies has the sunken spire and rapidly increasing whorls which characterize *H. Filholi* and separate it from any other known form. I therefore propose to create for its reception a new genus, placing it provisionally next to *Hygromia*.

¹ Proc. Acad. Nat. Sci. Philadelphia, 1853, p. 268.

² Malak. Blätt., xxiv, p. 8.

³ πλέγμα, in allusion to the reticulate sculpture.

⁴ Land u. Süsww. Conch. Vorwelt, p. 287.

⁵ δακτύλος, finger; μορφή, form.

⁶ Catal. Méth. foss. Bouches du Rhone, 1843, p. 207.

⁷ Mém. Soc. Emul. Provence, vol. i, 1862, p. 203; Roman, Bull. Soc. Géol. France, ser. IV, vol. iii, 1903, p. 590, fig. 8.

⁸ Bull. Soc. Géol. France, ser. IV, vol. iii, 1903, p. 598, fig. 13, and pl. xx, figs. 11-13.

⁹ Fauna Paläarct. Binnenconch., vol. iii, p. 87.

¹⁰ Malac. Prov. Comasca, 1838, p. 57, pl. i, fig. 4.

EURYSTROPHE, n.g.¹

Shell dextral, depressed, covered with minute elongated tubercles, arranged in quincunx; whorls few (four in the type), last rapidly increasing, equalling the earlier three in width, contracted behind the peristome; apex sunken below the level of the later whorls.

Type, *Helix Filholi*, Bourguignat.²



I would take the opportunity to make two rectifications of generic nomenclature in Professor Pilsbry's great work on the classification of the Helicidæ.³ On p. 277 *Helix unidentata* is indicated as the type of the section *Perforatella*, Schlüter, of the genus *Hygromia*. Now Pilsbry could not have seen Schlüter's work, since that author cites *Helix bidentata*, Gmelin [= *H. bidens*, Chemn.], as the only species under his *Perforatella*,⁴ which name must, therefore, supersede *Dibothrion*, Pfeiffer (1855), given for the next section on p. 278 of the Manual.

For the group of *Helix unidentata*, *Petasina*, Beck (1847),⁵ must be adopted. Beck included in this section *Helix Cobresiana*, Alten, *H. fulva*, Müller, *H. trochiformis*, Mont., and *H. Fabricii*, Beck. Eliminating the last three, which are now referred to the zonitoid genus *Euconulus*, the only species fixing the type is *H. Cobresiana*, which is synonymous with *H. edentula*, Drap., an earlier name. Pilsbry indicates *Petasina*, Mörch, Catal. Yoldi, 1852, p. 6, as a synonym of *Perforatella*. On turning to Mörch's work it will be found, however, that he quotes Beck as the authority for the name *Petasina*.

The synonymy of these two sections will therefore stand as follows:—

Section PETASINA, Beck, 1847.

Type, *H. edentula*, Drap.

Section PERFORATELLA, Schlüter, 1838.

Petasia, Beck, 1837 (preocc.), *Trochiscus*, Held, 1837 (preocc.), *Dibothrion*, Pfeiffer, 1855.

Type, *H. bidens*, Chemn.

¹ εὐρύ, wide; στροφή, turning, whorl.

² Bull. Soc. Sci. Toulouse, vol. i, p. 441, 1873; Bibl. École Hautes Études, Sci. Nat., vol. xvi, art. i, p. 278, pl. xxvii, figs. 5-8, 1877; Ann. Sci. Géol. (Hébert), viii, p. 278, pl. xxvii, figs. 5-8, 1877.

³ Manual of Conchology, ser. II, vol. ix, 1894.

⁴ System. Verz., 1838, p. 4.

⁵ Amtl. Ber. Versamml. Deutsch. Naturf. Kiel, 1847, p. 122.

ON THE MODIFICATIONS IN FORM OF THE UPPER TERTIARY
LACUSTRINE SHELLS OF THE ISLAND OF COS, AS FIRST
OBSERVED BY EDWARD FORBES AND T. A. B. SPRATT.

By R. BULLEN NEWTON, F.G.S.

Read 9th June, 1911.

PLATE XII.

AN abundant freshwater molluscan fauna characterizing the Upper Tertiary deposits of Southern Europe and Asia Minor has long proved a fascinating study to the palæoconchologist. To German writers we are mainly indebted for our present knowledge of the subject, the beds having been described as consisting of alternating sands and clays which frequently rise to considerable elevations, as in Slavonia, Austria, where they reach more than 2,000 feet. The beds have been divided into two groups—an upper, known as *Paludinen-Schichten*, from the occurrence of the characteristic shell *Viviparus* or *Paludina*, and a lower, termed *Congerien-Schichten* on account of the frequently found Pelecypod genus *Congeria*. The upper group is included in the Pliocene system, whilst the other belongs to the uppermost part of the Miocene, known as the Pontian stage of that period.

Perhaps the most familiar memoir on the subject, so far at least as Slavonia is concerned, was that issued by Neumayr & Paul in 1875 under the title of “Die Congerien und Paludinenschichten Slavoniens und deren Faunen; ein Beitrag zur Descendenz-Theorie” (Abhandl. k. k. Geol. Reichs., vol. vii, pt. iii, pls. i–x, 1875). In this work the authors recognized three horizons as forming the *Paludinen-Schichten*, which were characterized by distinctive forms of *Viviparus* (= *Paludina*). The first or oldest contained smooth species of the genus, accompanied by equally smooth varieties of *Unio*; the second horizon showed carinated species associated with thick forms of *Unio* without ornament; and the third exhibited carinate or tubercled varieties occurring in company with highly ornamented *Unio*. The viviparoid shells exhibiting such mutations were regarded as having originated from the smooth form of *Viviparus Neumayri*, belonging to the most ancient of the deposits, the immediate ancestor of which species was stated by the authors to be *V. achatinoides* of Deshayes, originally described from the Miocene (Pontian Beds) formation of the Crimea.

The views here briefly enunciated, and which had an important bearing on the theory of evolution, brought a great reputation to the authors, who ever since have been quoted as the original exponents of so interesting a discovery.

Although somewhat late in the day to call in question the originality of these particular statements, it may surprise many students to learn that the phenomenon involved in Neumayr & Paul’s work had been observed many years previously by the great English naturalists Professor Edward Forbes and Lieutenant (afterwards Admiral) T. A. B. Spratt in connexion with another area of Southern Europe, situated in the Eastern Mediterranean, where the geological conditions were of

almost similar character with those of the Austrian district of Slavonia.

The present communication has been prepared, therefore, to revive an interest in an almost forgotten account of some lacustrine mollusca of late Tertiary age, found in the Island of Cos, Asia Minor, written by the authors referred to, which dealt with certain variations of sculpture noticeable in *Viviparus* and associated shells according to their vertical arrangement in the deposits, such changes being regarded as attributable to physical causes, involving alterations in the composition of the waters, which operated on the form of the shells during their periods of development. The notice was first published as an 'abstract' in 1846 in the Fifteenth Report of the British Association (p. 59)¹ under the title: "On a remarkable phenomenon presented by the Fossils in the Freshwater Tertiary of the Island of Cos," the full paper being included in the authors' work on *Travels in Lycia*, vol. ii, pp. 199–206, 1847, illustrated by woodcuts of Gastropodous shells and a geological section, a reprint of which was published in the same year in the *Edinburgh New Philosophical Journal*, vol. xlii, No. 84, pl. iii, pp. 271–5, 1847, but with the somewhat different title: "On the Tertiaries of the Island of Cos. With a plate of Fossil Shells."

In presenting an explanation of the views of these early observers, it might be only necessary to quote the British Association 'abstract', yet it seems desirable to reprint the paper itself *in extenso*, as it appeared in the *Travels in Lycia*, where no doubt it has hitherto been somewhat overlooked, having largely escaped the notice of subsequent students engaged in molluscan researches. This will now be given, together with a photographic reproduction of the original figures of the shells and sketch section of the deposits.

"When describing the freshwater Tertiaries of the Valley of the Xanthus, we referred to similar tertiaries in the Island of Cos. These were visited by us, on our voyage from Rhodes to rejoin the 'Beacon', after leaving Lycia. They present phenomena of striking interest and importance, and as they bear on the question of the possibility of a transmutation of species, we cannot do better than append a notice of them to this account of the geology of Lycia.

"The freshwater Tertiaries of Cos are of considerable extent.² They appear to belong to the same geological period with those of the valleys of Xanthus and Cibyra.

"We have seen that those Lycian freshwater beds were of date posterior to the Miocene marine formations of the same region. Thus we get an ante-date; and in Cos we get a distinct after-date, for there the same beds, or what were probably beds of the same age, form the walls of a Tertiary basin of later date. This basin consists of a well-defined series of marine deposits, containing numerous newer Pliocene fossils, identical with those of Rhodes and Sicily. The Cos freshwater beds, and those of Lycia, may therefore be regarded as older Pliocene at latest. [Then follows a notice of the marine newer Pliocene beds] . .

¹ The present writer is indebted to Dr. A. S. Woodward, F.R.S., for directing his attention to this paper.

² According to De Lapparent they attain an altitude of 380 metres (*Traité de Géologie*, 5th ed., p. 1642, 1906).

"In the freshwater strata, against which the marine newer Pliocene beds abut unconformably, there are also numerous and well-preserved fossils: shells of *Paludina*, *Neritina*, *Melanopsis*, *Valvata*, *Unio*, *Cyclas*, and *Planorbis* occur, marking the nature of the deposits. With them teeth of a *Cyprinus* were found, also leaves and stems of plants, and in the uppermost stratum shells of the common cockle.

"The great interest of this formation depends on certain appearances presented by the mollusca of the genera *Paludina*, *Melanopsis*, and *Neritina* found in great quantities in several parts of it. They occur distributed in distinct horizons throughout the vertical thickness of the section. These horizons form three series, each of which is characterized by a peculiar form of *Paludina* and of *Neritina* not present in the other two, and in the two lower horizons there are two species of *Melanopsis* peculiar to each.

"So very different are the several fossils of one zone from those of another that at first examination we appear to have before us very distinct and well-marked species, and that each series of horizons was characterized by *Paludinæ*, *Neritinæ*, and *Melanopsides*, peculiar to itself, and representative of those inhabiting the other divisions. This would be a very startling phenomenon to occur within so limited an area. If the successive species be considered distinct, we must regard them as mutually representative, and hold that a succession of creations and extinctions took place, in this probably limited basin, during a brief geological period, or else that a transmutation of species took place.

"A careful study of the forms in question, and an enquiry into the modes and capacity of variation of species in the genera to which they belong, and among their allies, have convinced us, however, that these curious changes of form may be accounted for otherwise, and that in the successive *Paludinæ*, *Neritinæ*, etc., we have before us only the same species assuming protean variations. By reference to the figures it will be seen that the *Paludinæ* and *Neritinæ*, of the first or lowest zone, have smooth and unwrinkled shells; that those of the second have their shells belted by a strong fold or corrugation, whilst those of the uppermost zone are deeply sulcated and surrounded by strong spiral ridges.

"Such changes of form take place among *Littorinæ* and *Neritinæ*, even now, in places where alternations of fresh and salt water affect the mollusca, and in brackish-water localities. There are phenomena in the Cos beds which warrant us in referring the remarkable peculiarities of the fossils therein found to a similar cause. That an influx of salt water changed the character of the basin in which they lived towards the close of its existence is evident from the presence of the *Cardium edule* in its uppermost part. That some such cause had previously been in action is probable from the fact that the pulmoniferous testacea found in this formation are confined to the lowest series of horizons. One of the authors has elsewhere shown that no species of mollusk can live for any length of time on the same ground.

"A change of ground is necessary for its prosperity; otherwise it dies off. But, as the fry of even the most sedentary testacea are active creatures of a different form, organised for swimming, when all the adult animals upon a ground are destroyed, their descendants may survive their destruction and replace them, providing the ground be sufficiently changed during the interval.

"Now these two facts, first of the nature and causes of the variations among such testacea as present such curious changes of form in the Cos fresh-water beds, and second, of the necessity of a change of ground for the well-being of a species, and the manner in which, owing to the nature of the larva, such change may be effected on the same spot, have led us to propose the following solution of the Cos problem.

"The lowest series of horizons were deposited in the basin when it was purely a fresh-water one, and in it we found *Paludinæ*, etc., in their normal condition, associated with ordinary fresh-water mollusca. These latter are killed off by an influx of salt water, sufficient to render the basin slightly brackish. This influx takes place at a time when the mollusks of the uppermost

horizon in the lowest series have exhausted their ground, whilst at the same time their fry are swimming in the manner of Pteropods through the waters.

"The adults are destroyed, but their descendants survive, so affected, however, by the change in the condition of the element as to assume a new form, and develop themselves under the aspect of distinct species. A second revolution of the same kind brings about a third, still more remarkable and apparently equally sudden, change, and the continued inroads of the sea at length revolutionise the character of the fauna, introduce marine testacea in the place of the freshwater species, and destroy the latter altogether.

"Such an explanation is consistent with what we now know of the modes of variation among freshwater mollusca, and accounts sufficiently for a very remarkable palæontological phenomenon, which at first glance appeared to afford strong support to the notion of a transmutation of species in time."

The great value of these observations on the Cos shells has been referred to from time to time by various writers. Leonard Horner, in his Anniversary Address before the Geological Society of London in 1847 (Quart. Journ. Geol. Soc., vol. iii, p. xlv, 1847), briefly alluded to the interesting phenomenon observed by the authors in their studies of the older Pliocene freshwater shells of the Island of Cos. Again, G. Wilson & Archibald Geikie, in their *Memoir of Edward Forbes*, 1861, p. 306, made mention of the "remarkable gradations in form exhibited by species of *Paludina* and *Neritina* arising from successive changes in the physical character of the area in which these forms lived", as contained in the researches of Forbes and Spratt.

Writing on some brackish-water fossils from Crete in 1864, H. M. Jenkins (Quart. Journ. Science, vol. i, pp. 413-21, 1864) stated that "the freshwater and estuarine strata which occur there contain fossils exhibiting remarkable modifications of form caused by the more or less adverse influences of the conditions under which they lived . . . as was shown by Professor Forbes". Reference was also made to the subject by Tschihatcheff¹ in 1869.

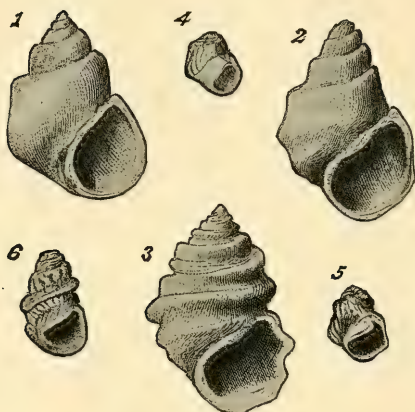
A few years later Gorceix began his geological work on the Island of Cos, and read a memoir before the Geological Society of France (Bull. Soc. Géol. France, ser. III, vol. ii, pp. 398-403, 1874), in which, however, no mention was made of the pioneer work of Forbes and Spratt, although during the discussion Tournouer (who subsequently described² the shells collected by that author) reminded Gorceix of the early studies of *Neritina*, *Paludina*, and *Melanopsis* carried out by the English observers.

Intimately connected with this subject, on account of similar geological and palæoconchological characteristics, were the studies of Neumayr & Paul on Slavonia published in 1875 (as previously mentioned). This memoir contained only brief references to the researches of Forbes and Spratt on the Island of Cos, the importance of whose views on the modification in form of the shells concerned was not fully appreciated by them at the time of publication of their monograph, a fact more or less proved in a subsequent memoir by Neumayr, "Ueber den Geologischen Bau der Insel Kos" (Denksch.

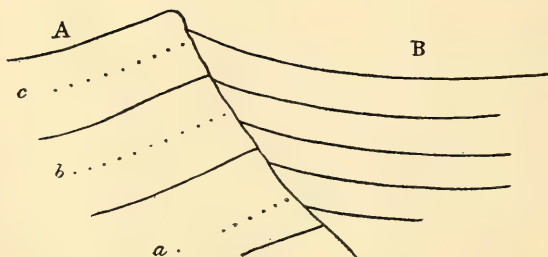
¹ *Asie Mineure*. Géologie, pt. iii: Terrain Tertiaire supérieur, pp. 189, 190, 1869.

² R. Tournouer, Ann. Sci. École Norm. Sup. [Paris], ser. II, vol. v, pp. 445-75, pls. i-iv, 1876.

TERTIARIES OF THE ISLAND OF COS



1 *Paludina* of lowest horizon, 2. of the second, and 3 of the uppermost zone. 4, 5, and 6, successive forms of *Neritina*.



Tertiaries of Cos. A, freshwater beds, a, b, c, successive series of fossiliferous zones. B, Marine Newer Pliocene beds.

k. Akad. Wiss., vol. xl, pls. i-iii, pp. 213-314, 1880), who acknowledged in a footnote (on p. 223) that Tournouer first directed attention to the important issues originating from the studies of the English authors, as well as recognizing a resemblance existing between the Cos and Slavonian shells.

Professor Judd, in a masterly review of the German monograph on Slavonia, under the title of "Palæontology and the Doctrine of Descent" (*Nature*, vol. xiv, pp. 275-6, 1876), eulogized its authors as furnishing "important evidence on the great question of evolution", but without reference to the earlier memoir of our own naturalists. It is not intended to minimize in any way the enormous value of the German treatise of 1875, but simply to point out that the primary results arrived at by Forbes and Spratt with regard to the Island of Cos were the same as those advanced nearly thirty years later by Neumayr & Paul in connexion with Slavonia. Neumayr & Paul illustrated their work with numerous figures of *Viviparus* and the other Mollusca found in the Slavonian deposits, and so made it possible to exhibit the various mutations in form from the smooth or oldest shells to those found in beds of later age presenting more complicated sculptures, such details being set out in a genetic table to better explain the ancestry of the different species of *Viviparus* as found in those beds. It is of interest to state that the British Museum (Natural History) now possesses a framed series of these species as illustrative of this genetic scheme, which is placed in the Geological Department.

It should be also mentioned that the shells from the Island of Cos obtained by Forbes and Spratt were deposited in the Museum of Practical Geology, Jermyn Street, London, and afterwards transferred, with other foreign collections, to the British Museum; but out of the six specimens figured in the original account only two can be identified at the present day as original types, these being determinable as *Viviparus coa*, Tournouer, and *Neritina coa*, Neumayr, which answer respectively to figures 3 and 5 of the series.

Through the researches of Tournouer and Neumayr it is possible to determine the species represented by the six figures given on the old plate of Forbes and Spratt, as follows (see Plate accompanying the present account):—

- | | | |
|---------|-------------------------------|--------------|
| Fig. 1. | <i>Viviparus Tournoueri</i> , | Neumayr. |
| „ 2. | <i>V. Forbesi</i> | } Tournouer. |
| „ 3. | <i>V. coa</i> ¹ | |
| „ 4. | <i>Neritina dorica</i> | } Neumayr. |
| „ 5. | <i>N. coa</i> | |
| „ 6. | <i>Neritina</i> , sp. indet. | |

¹ Not to be confused with an undescribed and unfigured form from the Island of Cos referred to by Neumayr & Paul as *Viviparus coa*, which is of smooth character, being related to *V. Fruchsi*, Neumayr, and therefore belonging to the oldest beds (Abhandl. k. k. Geol. Reichs., vol. vii, pt. iii, pl. x and its explanation, 1875). Neither should this shell be considered as *Paludina (Vivipara) Gorceixi* of Tournouer, as advocated by that author, which is less prominently ribbed (Ann. Sci. École Norm. Sup., ser. II, vol. v, pl. iii, fig. 5, p. 460, 1876).

Finally, although the views expressed by Forbes and Spratt may or may not be acceptable at the present day, it is claimed that those authors should be recognized as having first demonstrated the existence of certain variations of sculpture among the Upper Tertiary lacustrine shells of the Island of Cos, smooth forms only being found in the lowest or oldest beds, whilst those of more complicated ornamentation were restricted to the upper or later deposits of the formation, from which observations they were able to indicate that the beds were divisible into three series or horizons.

INDEX TO VOL. IX.

A † is prefixed to the names of fossil species.

A	PAGE		PAGE
<i>Achatina Ariel</i> , n.sp. (fig.) . . .	166	<i>Calliostoma Sowerbyi</i> . . .	7, 8
<i>Acmaea Bombayana</i> , n.sp. (fig.).	357	<i>Cardium rubescens</i> , n.sp. (fig.).	317
<i>Adeorbis</i>	259	<i>Cerastus delicatula</i> , n.sp. (fig.).	53
<i>Agardhia</i> , n.n., vice <i>Coryna</i> . . .	361	Chenu, <i>Illustr. Conchyl.</i> . . .	264
<i>Agatha vestalis</i> , n.sp. (fig.) . . .	178	<i>Chiton Hullianus</i> , n.n. . . .	103
<i>Allogenes</i> , n.g.	272	— <i>Suteri</i> , n.sp.	102
<i>Amphiblema</i> , n.g.	273	— <i>Torri</i>	227
<i>Ampullaria</i> , list of species	56	Chitons, Australasian	153
— <i>alucinans</i> , n.sp. (fig.)	63	<i>Choanopoma Rosenbergianum</i> , n.sp. (fig.)	359
— <i>nigricans</i> , n.sp. (fig.)	63	<i>Chondropoma Caymanense</i> , n.sp. (fig.)	360
<i>Ampullariidæ</i>	56	Christmas Island, shells from . .	315
<i>Anodonta Becklesi</i> , n.sp. (fig.) . .	116	Classification, Gastropod apex in	319
† <i>Archæoplecta</i> , n.g.	271	<i>Cleopatra</i> , animal	240
<i>Ariophanta bajadera</i>	281	<i>Conchological Illustrations</i> . .	212
<i>Asperitas</i> , n.g.	273	<i>Conus Beckeri</i> , n.sp. (fig.) . .	352
<i>Athoracophorus Schauinslandi</i> . .	6	Cooke, A. H., 'A Modification in the Form of Shell (<i>Siphonaria Algesiræ</i>) apparently due to Locality'	353
B		† Cos Island, Tertiary shells (figs.)	363
<i>Belemnites</i> , protoconch	87	Cox, J. C., 'Description of a new species of <i>Voluta</i> from West Australia'	146
— <i>Oweni</i>	225	<i>Cremnobates parva</i> (fig.) . . .	152
Bloomer, H. H., 'On the Anatomy of the British species of the genus <i>Psammobia</i> '	231	Crick, G. C., 'On <i>Belemnites Oweni</i> '	225
Boettger, Dr. O., obituary notice	279	<i>Cycliscus</i> , n.n., vice <i>Rotula</i> . . .	270
Bolten's genera of Veneridæ . . .	241	<i>Cymbium diadema</i>	226
<i>Brachydontes rufolineatus</i> , n.sp. (fig.)	318	<i>Cypræa</i>	44
<i>Buccinum oblitum</i> , n.sp. (fig.) . .	342	— <i>annulus</i> , with pearl	1
<i>Buliminus affinis</i> , n.sp. (fig.) . .	165	— <i>caput-serpentis</i> , immature . .	329
Bullen, R. A., 'Notes on (I) Pleistocene, (II) Holocene, (III) Recent non-marine Shells from Mallorca; (IV) Marine Shells associated with the Holocene deposits; (V) Marine Shells from Alcudia, Mallorca; (VI) Non-marine Shells from Manresa, Cataluna'	118	— <i>lynx</i> , abnormal	329
Burne, R. H., 'On the Anatomy of <i>Rhysota Foullioyi</i> '	208	D	
C		Da Costa's genera of Veneridæ . .	241
<i>Caducifer tessellatus</i>	227	<i>Dactylomorpha</i> , n.n., vice <i>Dac- tylius</i>	361
<i>Calliostoma haliarchus</i>	7, 8	Dall, W. H., 'Some remarks on the nomenclature of the Veneridæ'	349
		<i>Donovania fasciata</i> , n.sp. (fig.).	65
		<i>Drouetia</i> , n.g.	272
		Duclos, <i>Hist. nat. gén. Coquilles</i>	264

E	PAGE	PAGE
<i>Elaphroconcha</i> , n.g.	273	<i>Helicella caperata</i> , sinistral 1
<i>Elona Quimperiana</i>	227	— (<i>Lejeania</i>) <i>Rosenbergi</i> , n.sp. 165
<i>Elusa brunneomaculata</i> (fig.)	179	(fig.)
— <i>enelata</i> , n.sp. (fig.)	179	<i>Helicodonta Hispanica</i> , n.sp. 125
<i>Ennea Ansoergei</i> , n.sp. (fig.)	51	(fig.)
— <i>Meneleki</i> , n.sp. (fig.)	164	— <i>Salteri</i> , n.sp. (fig.) 268
— <i>Roberti</i> , n.sp. (fig.)	164	<i>Helix desertorum</i> , torpid six years 3
— <i>Rosenbergiana</i> , n.sp. (fig.)	52	— food in captivity 5
<i>Erato</i> , list of species	13	<i>Homorus Manuelli</i> , n.sp. (fig.) 54
<i>Eulimella Kaisensis</i> (fig.)	181	— <i>perlucida</i> , n.sp. (fig.) 168
— <i>maia</i> , n.sp. (fig.)	180	— <i>princeps</i> , n.sp. (fig.) 168
<i>Eurystrophe</i> , n.g.	362	<i>Humphreyia Strangei</i> , juv. (fig.) 23
F		
<i>Fissurella</i> (<i>Cremides</i>) <i>Keppeliana</i> , n.sp. (fig.)	66	
G		
Gastropod apex in classification.	319	
Geological Zones and Mollusca	282	
Godwin-Austen, H. H., 'Description of <i>Oxytes Beddomei</i> , n.sp., from Upper Burma'	327	
Gude, G. K., 'Notes on a collection of Helicoid Land Shells from New Guinea'	80	
— 'Description of a new species of <i>Helicodonta</i> from Spain'	124	
— 'Description of a new species of <i>Helicodonta</i> from Tenerife'	268	
— 'Note on some preoccupied Molluscan generic names and proposed new genera of the family Zonitidæ'	269	
— 'Further note on preoccupied Molluscan generic names and a proposed new genus of the family Helicidæ'	361	
H		
Haas, F., 'On <i>Unio</i> , <i>Margaritana</i> , <i>Pseudanodonta</i> , and their occurrence in the Thames Valley'	106	
<i>Haliotis</i> , type <i>H. asininus</i>	260	
<i>Hawaiiia</i> , n.g.	272	
Hedley, C., 'Note on <i>Chiton Torri</i> '	227	
— and Suter, H., 'The genus <i>Cremnobates</i> , Swainson'	151	
<i>Helicarion Hararensis</i> , n.sp. (fig.)	164	
I		
<i>Ilaira</i>	260	
Iredale, T., 'On Marine Mollusca from the Kermadec Islands, and on the " <i>Sinusigera</i> apex"'	68	
— 'Notes on Polyplacophora, chiefly Australasian'	90, 153	
— 'On some misapplied Molluscan Generic Names'	253	
— 'On the value of the Gastropod Apex in Classification'	319	
<i>Itiopiana</i> , n.sect.	169	
J		
Jones, K. H., and Preston, H. B., 'Notes on some species of Mollusca collected in China from 1904 to 1907, with descriptions of new species'	9	
Jukes-Browne, A. J., 'On <i>Petricola</i> , <i>Lucinopsis</i> , and the family Petricolidæ'	214	
— 'On the names used by Bolten and Da Costa for genera of Veneridæ'	241	
K		
<i>Kalendyma</i> , n.g.	273	
<i>Kalidos</i> , n.g.	273	
Kennard, A. S., 'On <i>Valvata Woodwardi</i> , n.sp., and <i>Sphaerium Bulleni</i> , n.sp., from the Cromerian (Forest Bed) of West Runton, Norfolk'	324	
— and Stelfox, A. W., 'On the occurrence in England of <i>Valvata macrostoma</i> , Steenbuch'	123	

	PAGE
<i>Keræa</i> , n.n., vice <i>Julus</i> . . .	271
Kermadec Chitons . . .	160
Kermadec Islands, Mollusca . . .	68

L

<i>Latirus Ernesti</i> , n.sp. (fig.) . . .	147
<i>Libera</i> , list of species . . .	37
<i>Limicolaria Jickeliana</i> , n.sp. (fig.) . . .	167
<i>Limnea (Gulnaria) Lumleyi</i> , n.sp. (fig.) . . .	10
— <i>Schwilpi</i> , n.sp. (fig.) . . .	10
— <i>Sinensis</i> , n.sp. (fig.) . . .	11
Lintner, J. E., obituary notice . . .	89
<i>Liotia</i> . . .	257
<i>Lithasiopsis</i> , n.g. . . .	47
— <i>Hinkleyi</i> , n.sp. (fig.) . . .	48
— <i>Mexicanus</i> , n.sp. (fig.) . . .	49
Longstaff, G. B., 'Note on feeding of <i>Helix desertorum</i> , Forsk., in captivity' . . .	5

M

<i>Macrochlamys pedina</i> . . .	281
— <i>platychlamys</i> . . .	281
Mallorca, shells from . . .	118
<i>Margaritana</i> . . .	106
— <i>margaritifera</i> . . .	126
<i>Melania Goramensis</i> , n.sp. (fig.) . . .	228
— <i>Keiensis</i> , n.sp. (fig.) . . .	229
— <i>Stalkeri</i> , n.sp. (fig.) . . .	228
<i>Melo</i> , egg-capsules . . .	4
Melville, J. C., 'Note on the identity of <i>Calliostoma Sowerbyi</i> , Pilsbry, with <i>C. haliarchus</i> , Melville' . . .	7
— 'Description of a new species of <i>Latirus</i> ' . . .	147
— 'A revision of the species of the family Pyramidellidæ occurring in the Persian Gulf, Gulf of Oman, and North Arabian Sea, . . . with descriptions of new species' . . .	171
<i>Miralda idalima</i> (fig.) . . .	195
— <i>opephora</i> (fig.) . . .	196
<i>Mitra biconica</i> , n.sp. (fig.) . . .	334

N

<i>Nassa exulata</i> , n.sp. (fig.) . . .	316
<i>Nautilus pompilius</i> , abnormal . . .	2, 4
<i>Neocyclotus fonticulus</i> , n.sp. (fig.) . . .	359
<i>Neptunea (Sipho) attenuata</i> (fig.) . . .	337
— <i>pertenuis</i> , n.sp. (fig.) . . .	339

Neritidæ, anatomy (figs.) . . .	27
† <i>Neritina coa</i> (fig.) . . .	367
† — <i>dorica</i> (fig.) . . .	367
† — sp. indet. (fig.) . . .	367
<i>Nesæcia</i> , n.n., vice <i>Rotularia</i> . . .	270
New Guinea, land shells . . .	80
Newton, R. B., 'On an undescribed <i>Anodonta</i> from the English Wealden formation, with remarks on the other Unionidæ of the same period' . . .	114
— 'A Sketch of the chief Geological Zones and their Mollusca' . . .	282
— 'On the modifications in form of the Upper Tertiary lacustrine shells of the Island of Cos, as first observed by Edward Forbes and T. A. B. Spratt' . . .	363
<i>Newtoniella</i> . . .	260
<i>Nitor</i> , n.n., vice <i>Thalassia</i> . . .	270

O

Obituary notices . . .	89, 279
<i>Odostomia anabathmis</i> , n.sp. (fig.) . . .	203
— <i>chariclea</i> , n.sp. (fig.) . . .	204
— <i>eutropia</i> , var. <i>crassispira</i> (fig.) . . .	205
— <i>zaleuca</i> , n.sp. (fig.) . . .	206
<i>Omalaxis</i> . . .	253
<i>Oscilla evanida</i> , n.sp. (fig.) . . .	194
<i>Oxytes Beddomei</i> , n.sp. (fig.) . . .	327
— <i>Shanensis</i> (fig.) . . .	328

P

<i>Pachychilus violaceus</i> , n.sp. (fig.) . . .	229
<i>Papuina rhodochila</i> , n.sp. (fig.) . . .	82
Peile, A. J., 'Note on <i>Triton tessellatus</i> , Reeve' . . .	227
— 'Note on <i>Macrochlamys (Eurychlamys) platychlamys</i> (Blanford), etc.' . . .	281
<i>Perforatella</i> , Schlüter . . .	362
<i>Peristernia venusta</i> , n.sp. (fig.) . . .	316
<i>Petasina</i> , Beck . . .	362
<i>Petricola pholadiformis</i> . . .	278
<i>Phasianella Kraussi</i> , n.sp. (fig.) . . .	313
<i>Phenacolepas mirabilis</i> , n.sp. (fig.) . . .	66
<i>Phlegma</i> , n.n., vice <i>Cœlatura</i> . . .	361
Pilsbry, H. A., 'A new Mexican genus of <i>Pleuroceratidæ</i> ' . . .	47
<i>Pisania lirocincta</i> , n.sp. (fig.) . . .	65
<i>Pisidium Lilljeborgii</i> . . .	5, 150

	PAGE
<i>Pisidium Steenbuchii</i> . . .	5, 150
<i>Plaziphora Matthewsii</i> , n.sp. . .	99
Polyplacophora, Australasian . .	90, 153
Ponsonby, J. H., 'Note on <i>Sculptaria</i> , Pfeiffer' . . .	34
— 'Notes on the genus <i>Libera</i> ' . . .	37
'Porcupine' Mollusca . . .	331
Presidential Address . . .	282
Preston, H. B., 'Notes on a small collection of Terrestrial Shells from Angola, with descriptions of new species' . .	51
— 'Description of <i>Vivipara</i> <i>fragilis</i> , n.sp., from Dutch New Guinea' . . .	113
— 'Notes on and additions to the Terrestrial Molluscan Fauna of Southern Abyssinia' . .	163
— 'Note on a new Armorican locality for <i>Elona Quimperiana</i> , Fér.' . .	227
— 'Descriptions of new Melaniidæ from Goram and Kei Islands, Malay Archi- pelago' . . .	228
— 'Description of a new species of <i>Pachychilus</i> from Cuba' . . .	229
— 'Diagnoses of three new Operculate Land Shells from Grand Cayman Island' . . .	359
— see Jones, K. H., and Preston, H. B. . . .	9
<i>Psammobia</i> , anatomy (figs.) . .	231
<i>Pseudanodonta</i> . . .	106
<i>Pseudoglossula minuscula</i> , n.sp. (fig.) . . .	54
<i>Psichion</i> , n.g. . . .	272
Pyramidellidæ, Persian Gulf, etc. . . .	171
<i>Pyrgulina comacum</i> , n.sp. (fig.) .	198
— <i>crystallopecta</i> , n.sp. (fig.) . .	199
— <i>Dautzenbergi</i> , n.sp. (fig.) . .	199
— <i>eccrita</i> , n.sp. (fig.) . . .	200
— <i>edana</i> , n.sp. (fig.) . . .	200
— (<i>Egilina</i>) <i>chasteriana</i> , n.sp. (fig.) . . .	197
— <i>milicha</i> , n.sp. (fig.) . . .	201
— <i>pirinthella</i> , n.sp. (fig.) . .	201
— <i>polemica</i> , n.sp. (fig.) . . .	202
— <i>redempta</i> , n.sp. (fig.) . . .	202
— <i>zidora</i> , n.sp. (fig.) . . .	203

Q

<i>Quoyia</i>	259
-------------------------	-----

R

Rafinesque's genera	261
Reynell, A., 'Further Notes on the Dates of Issue of the Parts of Sowerby's <i>Conchological</i> <i>Illustrations</i> '	212
<i>Rhysota Foulliouyi</i> , anatomy . .	208
<i>Rothvenia</i> , n.n., vice <i>Sykesia</i> . .	271

S

<i>Sculptaria</i> , list of species . . .	34
Shaw, H. O. N., 'A further note on the anatomical differences between the genera <i>Cypræa</i> and <i>Trivia</i> '	44
— 'Notes on the references to certain Groups, etc., used in the Classification of Mollusca' . .	45
Sherborn, C. D., and Smith, E. A., 'A Collation of J. C. Chenu's <i>Illustrations Conchy- liologiques</i> , and a note on P. L. Duclos' <i>Hist. nat. gén. et part. Coquilles</i> '	264
Simroth, H., 'Some remarks with regard to Professor Bourne's Monograph on the <i>Neritidæ</i> '	27
<i>Sinusigera apex</i>	74
<i>Siphonaria Algesiræ</i> (fig.) . . .	353
Smith, E. A., 'Note on an abnormal specimen of <i>Nautilus</i> <i>pompilius</i> '	4
— 'Note on the Egg-capsules of <i>Melo</i> '	4
— 'Notes on the genus <i>Erato</i> , with a list of the known recent species'	13
— 'Note on the very young stage of the genus <i>Hum- phreyia</i> '	23
— 'Description of <i>Thersites</i> (<i>Glyptorhagada</i>) <i>Hillieri</i> , n.sp., from South Central Australia'	26
— 'Note on the Animal of the genus <i>Cleopatra</i> '	240
— 'On the recent species of the genus <i>Vulsella</i> '	306
— 'On a new species of <i>Phasianella</i> from South Africa'	313
— 'A list of Marine Shells occurring at Christmas Island, Indian Ocean, with descrip- tions of new species'	315
— 'Description of a new species of <i>Acmæa</i> from	

	PAGE
Bombay, and notes on other forms from that locality' . . .	356
Smith, E. A., see Sherborn, C. D., and Smith, E. A.	264
Sowerby, G. B., 'Notes on the family Ampullariidæ' . . .	56
— 'Descriptions of new species of <i>Donovania</i> , <i>Pisania</i> , <i>Phenacolepas</i> , and <i>Fissurella</i> ' . . .	65
— 'Description of a new species of the genus <i>Conus</i> from South Africa' . . .	352
† <i>Sphærium Bulleni</i> , n.sp. (fig.)	325
Stelfox, A. W., see Kennard, A. S., and Stelfox, A. W. . . .	123
<i>Strombus gigas</i> , abnormal . . .	226
— <i>quadratus</i> , var.	329
<i>Styloptygma beatrix</i> , n.sp. (fig.)	176
— <i>cometes</i> , n.sp. (fig.) . . .	177
<i>Subulina (Itiopiana) Meneleki</i> , n.sp. (fig.)	169
— — <i>nympha</i> , n.sp. (fig.) . . .	170
— — <i>vicina</i> , n.sp. (fig.) . . .	169
<i>Succinea Gimlettei</i> , n.sp. (fig.) .	10
Suter, H., 'Note on <i>Athoracophorus Schauinslandi</i> '	6
— see Hedley, C., and Suter, H. .	151
Sykes, E. R., 'On the Mollusca procured during the "Porcupine" Expeditions, 1869-70. Supplemental Notes, Part IV' .	331
<i>Syrnola clearete</i> , n.sp. (fig.) . .	175
— <i>Karachiensis</i> (fig.) . . .	175
T	
<i>Thapsia innocens</i> , n.sp. (fig.) . .	53
<i>Thapsiella</i> , n.g.	272
<i>Thersites (Glyptorhagada) Hillieri</i> , n.sp. (fig.)	26
<i>Trachysma</i>	257
<i>Trivia</i>	44
<i>Turbonilla basilica</i> (fig.) . . .	182
— <i>colpodes</i> , n.sp. (fig.) . . .	183
— <i>eucteana</i> , n.sp. (fig.) . . .	183
— <i>eumenes</i> , n.sp. (fig.) . . .	184
— <i>fraterna</i> , n.sp. (fig.) . . .	184
— <i>galactodes</i> , n.sp. (fig.) . . .	185
— <i>icela</i> , n.sp. (fig.)	185
— <i>julia</i> , n.sp. (fig.)	186
— <i>Michaelis</i> , n.sp. (fig.) . . .	187
— <i>neogila</i> , n.sp. (fig.)	187
— <i>oligopleura</i> , n.sp. (fig.) . . .	188
— <i>pachypleura</i> , n.sp. (fig.) . .	188
— <i>Phyllidis</i> , n.sp. (fig.) . . .	188
— <i>punctillum</i> , n.sp. (fig.) . .	189

	PAGE
<i>Turbonilla quæstuosa</i> , n.sp. (fig.)	189
— <i>Sykesii</i> , n.sp. (fig.)	190
— <i>templaris</i> (fig.)	191
— <i>Townsendi</i> , n.sp. (fig.) . . .	191
— <i>unicincta</i> , n.sp. (fig.) . . .	192
— <i>zetemia</i> , n.sp. (fig.)	192
U	
<i>Unio</i>	106
V	
<i>Valvata macrostoma</i>	123
† — <i>Woodwardi</i> , n.sp. (fig.) . .	324
<i>Vasum rhinoceros</i> , sinistral . . .	226
Veneridæ, Bolten's genera . . .	241
— Da Costa's genera	241
— nomenclature	349
<i>Vivipara fragilis</i> , n.sp. (fig.) . .	113
† <i>Viviparus coa</i> (fig.)	367
† — <i>Forbesi</i> (fig.)	367
† — <i>Tournoueri</i> (fig.)	367
<i>Voluta Deshayesi</i>	226
— <i>nodiplicata</i> , n.sp. (fig.) . . .	146
— <i>Prevostiana</i>	226
<i>Vulsella</i> , list of species (figs.) .	306
W	
Walker, B., 'The distribution of <i>Margaritana margaritifera</i> (Linn.) in North America' . .	126
Watson, Rev. R. B., obituary notice	279
Whidborne, G. F., obituary notice	89
Woodward, B. B., 'On the occurrence in the British Isles of living specimens of <i>Pisidium Steenbuchii</i> , Mörch, and <i>P. Lilljeborgii</i> , Clessin, with notes of new records of <i>Pisidia</i> for the Lake District, and fresh localities for <i>P. supinum</i> , A. Schm.'	5
— 'Note on further British localities for <i>Pisidium Steenbuchii</i> , Möller, and <i>P. Lilljeborgii</i> , Clessin'	150
Z	
<i>Zophos</i> , n.n., vice <i>Morchia</i> . . .	269

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